



National Aeronautics and Space Administration

Budget Estimates

FISCAL YEAR **1988**

Volume II

Construction of Facilities

CONTENTS

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1988 ESTIMATES

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SUMMARY
INFORMATION

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

CONSTRUCTION OF FACILITIES

GENERAL :

The Construction of Facilities (CoF) appropriation provides contractual services for the repair, rehabilitation and modification of existing facilities; the construction of new facilities; the acquisition of related facility equipment; the design of facilities projects; and advance planning related to future facilities needs.

The funds requested for 1988 provide for: the continuation of prior year endeavors in meeting the facilities requirements for Space Flight and the Space Station Programs; modification of aeronautical research and development facilities; repair, rehabilitation and modification of other facilities to maintain, upgrade and improve the usefulness of the NASA physical plant; minor construction of new facilities; facility planning and design activities; and environmental compliance and restoration.

The projects and amounts in the budget estimate reflect Space Flight requirements that are time sensitive to meet specific milestones. Other program requirements for 1988 include the construction of a spacecraft systems development and integration facility as well as modifications for utility reliability at the Goddard Space Flight Center; construction of an integrated test facility at Dryden Flight Research Facility; modifications to the Hypersonic Propulsion Facility for Vacuum Systems at the Langley Research Center; construction of an addition to the Research Analysis Center and Modifications for Fan/Compressor Research to the Engine Research Building at the Lewis Research Center; and the construction of a Communications Development Antenna at Goldstone, California.

The FY 1988 program continues to meet the objectives of preserving and enhancing the capabilities and usefulness of existing facilities and ensuring safe economical and efficient use of the NASA physical plant. This request continues the necessary rehabilitation and modification program begun in prior years and continues a repair program. The purpose of the repair program is to restore facilities to a condition substantially equivalent to their originally designed capability. The minor construction program continues to provide a means to accomplish smaller facility projects which accommodate changes in technical and institutional requirements. The Environmental Compliance and Restoration Program will assure that statutory environmental requirements will be met and any necessary remedial action promptly taken.

Funds requested for facility planning and design cover advance planning and design requirements for potential future projects, master planning, facilities studies, engineering reports and studies and the preparation of facility project design drawings and bid specifications.

The budget authority requested for FY 1988 is \$195,500,000, with estimated outlays of \$151,749,000.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

PROPOSED APPROPRIATION LANGUAGE

CONSTRUCTION OF FACILITIES

For construction, repair, rehabilitation and modification of facilities, minor construction of new facilities and additions to existing facilities, and for facility planning and design not otherwise provided, for the National Aeronautics and Space Administration, and for the acquisition or condemnation of real property, ~~as~~ authorized by law, ~~[\$186,300,000]~~ **\$195,500,000**, to remain available until September 30, ~~[1989]~~ **1990: *Provided***, That, notwithstanding the limitation on the availability of funds appropriated under this heading by this appropriations Act, when any activity has been initiated by the incurrence of obligations therefor, the amount available for such activity shall remain available until expended, except that this provision shall not apply to the amounts appropriated pursuant to the authorization for repair, rehabilitation and modification of facilities, minor construction of new facilities and additions to existing facilities, and facility planning and design: ***Provided further***, That no amount appropriated pursuant to this or any other Act may be used for the lease or construction of a new contractor-funded facility for exclusive use in support of a contract or contracts with the National Aeronautics and Space Administration under which the Administration would be required to substantially amortize through payment or reimbursement such contractor investment, unless an appropriations Act specifies the lease or contract pursuant to which such facilities are to be constructed or leased or such facility is otherwise identified in such Act: ***Provided further***, That the Administrator may authorize such facility lease or construction, if he determines, in consultation with the Committees on Appropriations, that deferral of such action until the enactment of the next appropriations Act would be inconsistent with the interest of the Nation in aeronautical and space activities. *(Additional authorizing legislation to be proposed.)*

Note.—Public Laws 99-500 and 99-591, section 101(g), provide funds to the extent and in the manner provided for in the conference version of H.R. 5313, Department of Housing and Urban Development-Independent Agencies Appropriations Act, 1987.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
OFFICE OF MANAGEMENT BUDGET
CONSTRUCTION OF FACILITIES
FISCAL YEAR 1988 ESTIMATES
SUMMARY OF THE BUDGET PLAN BY LOCATION
(Thousands of Dollars)

<u>Location</u>	<u>Fiscal Year 1986</u>	<u>Fiscal Year 1987</u>	<u>Fiscal Year 1988 Agency Request</u>
Lyndon B. Johnson Space Center.....	---	a,750	---
Space Station Facilities.....	---	12,500	25,800
Space Flight Facilities.....	32,620	3,300	17,000
Space Shuttle Payload Facilities.....	975	---	---
Goddard Space Flight Center.....	3,610	7,750	11,500
Jet Propulsion Laboratory.....	9,400	12,000	---
Ames Research Center.....	7,800	9,100	---
Hugh L. Dryden Flight Research Facility.....	---	7,500	10,500
Langley Research Center.....	4,650	11,300	3,100
Lewis Research Center.....	---	---	16,300
Various Locations.....	16,730	21,350	6,400
Repair	20,035	23,300	25,000
Rehabilitation and Modification.....	25,000	29,100	32,000
Minor Construction.....	6,000	6,850	8,000
Facility Planning and Design.....	10,710	13,500	16,000
Environmental Compliance and Restoration.....	---	---**	23,900
Total Plan.....	<u>137,530*</u>	<u>166,300</u>	<u>195,500</u>

* Reflects Inclusion of \$4220K Transferred 11/21/86,
from Space Flight Control and Data Communications

** \$5,000K Included in R&PM in 1987 to Begin These
Activities

SUMMARY OF BUDGET PLAN BY COGNIZANT OFFICE
(Thousands of Dollars)

	Fiscal Year <u>1986</u>	Fiscal Year <u>1987</u>	<u>Fiscal Year 1988</u> Agency <u>Request</u>
Office of Space Station.....	---	12,500	25,800
Office of Space Flight	33,595	12,050	17,000
Office of Space Science and Applications.....	13,010	19,750	11,500
Office of Aeronautics and Space Technology.....	12,450	27,900	29,900
Office of Space Tracking and Data System.....	16,730	21,350	6,400
Office of Management	<u>61,745</u>	<u>72,750</u>	<u>104,900</u>
TOTAL PLAN.....	<u>137,530</u>	<u>166,300</u>	<u>195,500</u>

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
OFFICE OF MANAGEMENT AND BUDGET
FISCAL YEAR 1988 ESTIMATES
CONSTRUCTION OF FACILITIES
BY AUTHORIZATION LINE ITEM
(Thousands of Dollars)

ORGANIZANT OFFICE	BUDGET ACTIVITY	SUBFUNCTION CODE	Installation and Project	Fiscal Year 1986	Fiscal Year 1987	Fiscal Year 1988 Agency Request	Page No.
SF	7	255	JOHNSON SPACE CENTER,	---	8,750	---	
			Construction of Central Computing Facility	---	8,750	---	
			<u>SPACE STATION FACILITIES AT VARIOUS LOCATIONS, AS FOLLOWS:</u>	---	12,500	25,800	
SS	1	253	Construction of Addition to Mission Control Center (JSC)	---	---	15,800	CF 1-1
SS	1	253	Construction of Addition to the Simulator/Training Facility (JSC)	---	---	3,400	CF 1-9
SS	1	253	Construction of Space Station Processing Facility (KSC)	---	---	3,600	CF 1-17
SS	1	253	Modifications of Process Technology Facility for Space Station (MSFC)	---	---	3,000	CF 1-23
SS	1	253	Construction of Addition to the System Integration and Mockup Laboratory (JSC)	---	4,850	---	
SS	1	253	Construction of Power Systems Facility (LeRC)	---	5,600	---	
SS	1	253	Modifications to Test Stand 300 for Space Station Hydrogen/ Oxygen Propulsion System Development (MSFC)	---	2,050	---	
			<u>SPACE FLIGHT FACILITIES AT VARIOUS LOCATIONS, AS FOLLOWS:</u>	32,620	3,300	17,000	
SF	1	253	Construction of LC 39 Operations Support Building (KSC)	---	---	17,000	CF 2-1
SF	1	253	Construction of Addition to Orbiter Processing Facility Annex (KSC)	---	3,300	---	
SF	1	253	Construction of Orbiter Modification and Refurbishment Facility (KSC)	13,300	---	---	
SF	1	253	Construction of Thermal Protection System Facility (KSC)	3,500	---	---	
SF	1	253	Modifications for Advanced Technology Engine Test Stand Stand S-1C (MSFC)	6,500	---	---	
SF	1	253	Modification of B-1 Test Position for Single SSME Testing (NSTL)	4,220	---	---	SF1253
SF	1	253	Modifications for Enhanced Life Support System Testing (JSC)	700	---	---	
SF	1	253	Modifications to Pad A Payload Change-Out Roan (KSC)	1,900	---	---	
SF	1	253	Modifications to Space Shuttle Main Engine Support Systems (NSTL)	2,500	---	---	

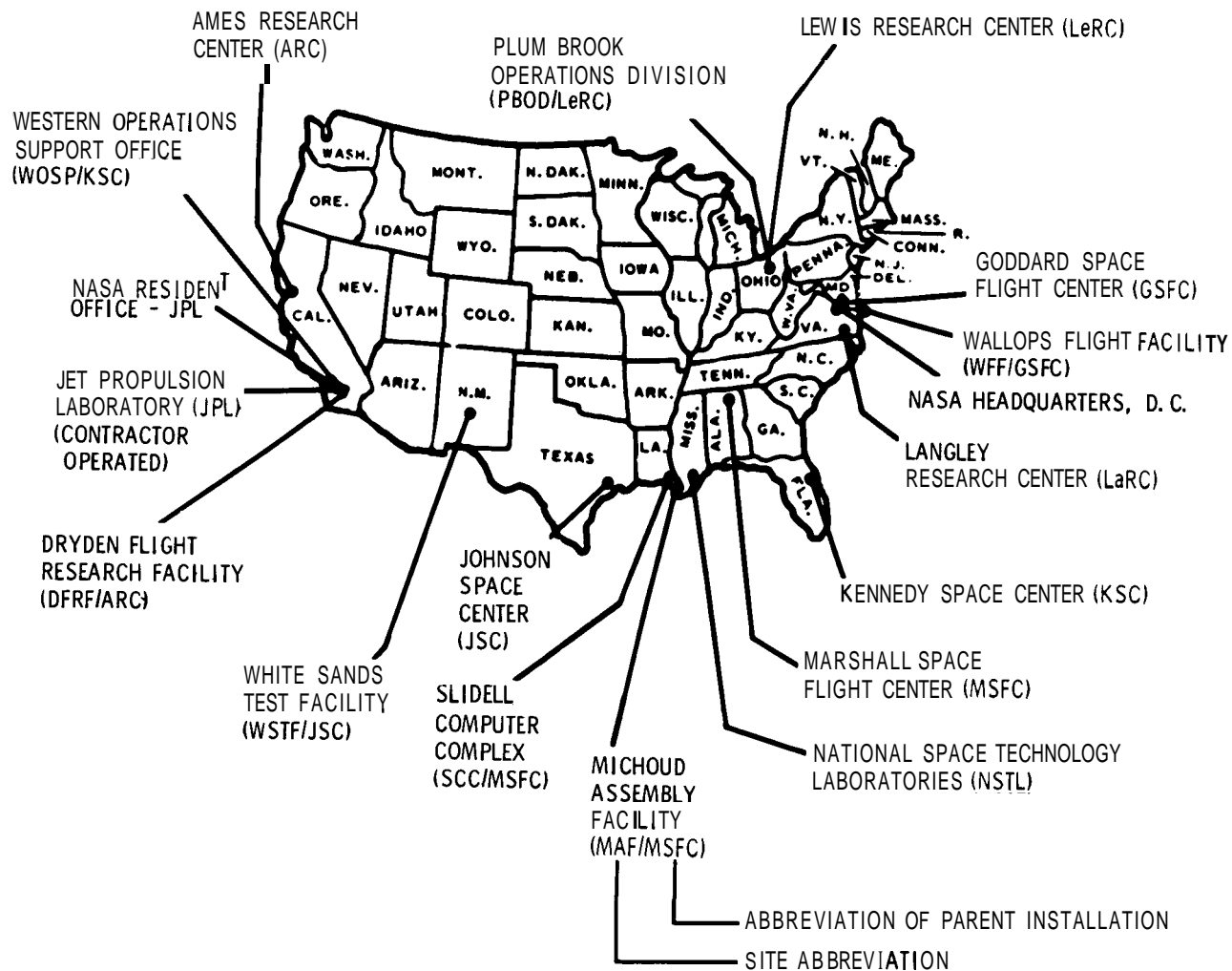
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COGNIZANT OFFICE	BUDGET ACTIVITY	SUBFUNCTION CODE	Installation and Project	Fiscal Year 1986	Fiscal Year 1987	Fiscal Year 1988 Agency Request	Page No.
<u>SPACE SHUTTLE PAYLOAD FACILITIES AT VARIOUS LOCATIONS,</u>							
<u>As FOLLOWS:</u>				975	---	---	
SF	2	254	Construction of Payload Control Rooms (KSC)	975	---	---	
<u>GODDARD SPACE FLIGHT CENTER</u>				3,610	7,750	11,500	
SSA	2	254	Construction of Spacecraft System Development and Integration Facility	---	7,750	8,600	CF 3-1
SSA	7	255	Modifications for Utility Reliability	---	---	2,900	CF 3-9
SSA	7	254	Construction of Addition to Research Project Laboratory	3,610	---	---	
<u>JET PROPULSION LABORATORY</u>				9,400	12,000	---	
SSA	7	255	Construction of Engineering Support Building	---	9,500	---	
SSA	7	255	Modification of Uninterruptible Power System in Space Flight Operations Facility	---	2,500	---	
SSA	7	255	Construction of Microdevices Laboratory	9,400	---	---	
<u>AMES RESEARCH CENTER</u>				7,800	9,100	---	
AST	4	254	Construction of Human Performance Research Laboratory	---	9,100	---	
AST	5	402	Construction of Numerical Aerodynamic Simulation Facility	7,800	---	---	
<u>DRYDEN FLIGHT RESEARCH FACILITY</u>				---	7,500	10,500	CF 4-1
AST	5	402	Construction of Integrated Test Facility	---	7,500	10,500	
<u>LANGLEY RESEARCH CENTER</u>				4,650	11,300	3,100	
AST	5	402	Modifications to Hypersonic Propulsion Facility for Vacuum Systems	---	---	3,100	CF 5-1
AST	5	402	Construction of Addition for Non-Destructive Evaluation Research Laboratory	---	1,900	---	
AST	5	402	Modifications to 8-Foot High Temperature Tunnel	---	9,400	---	
AST	5	402	Modifications to 16-Foot Transonic Tunnel for Improved Productivity and Research Capability	4,650	---	---	
<u>LEWIS RESEARCH CENTER</u>				---	---	16,300	
AST	5	402	Construction of Addition to the Research Analysis Center	---	---	9,800	CF 6-1
AST	5	402	Modifications for Fan/Compressor Research, Engine Research Building	---	---	6,500	CF 6-9
							SUM 6

COGNIZANT OFFICE	BUDGET ACTIVITY	FUNCTION No.		Fiscal Year 1986	Fiscal Year 1987	Fiscal Year 1988 Agency Request	Page No.
			<u>Installation and Project</u>				
			<u>VARIOUS LOCATIONS</u>	<u>16,730</u>	<u>21,350</u>	<u>6,400</u>	
ST&DS	7	255	Construction of Communications Development Antenna, Goldstone, CA (JPL)	---	---	5,400	CF 7-1
ST&DS	7	255	Construction of the Second Tracking and Data Relay Satellite System Ground Terminal Facility in New Mexico.....	---	21,350	---	
ST&DS	7	255	Modification of 64-meter Antenna DSS-14, Goldstone, California (JPL)	8,500	---	---	
ST&DS	7	255	Modification of 64-Meter Antenna DSS-43, Canberra, Australia (JPL)	2,230	---	---	
MGMT	7	255	<u>Repair of Facilities at Various Locations, Not in Excess of \$750,000 Per Project</u>	<u>20,035</u>	<u>23,300</u>	<u>25,000</u>	CF 8-1
MGMT	7	255	<u>Rehabilitation and Modification of Facilities at Various Locations, Not in Excess of \$750,000 Per Project</u>	<u>25,000</u>	<u>29,100</u>	<u>32,000</u>	CF 9-1
MGMT	7	255	<u>Minor Construction of New Facilities and Additions to Existing Facilities at Various Locations, Not in Excess of \$500,000 Per Project</u>	<u>6,000</u>	<u>6,850</u>	<u>8,000</u>	CF 10-1
MGMT	7	255	<u>Facility Planning and Design.....</u>	10,710	13,500	16,000	CF 11-1
			Subtotal, Construction.....	137,530	166,300	171,600	
MGMT	7	255	<u>Environmental Compliance and Restoration Progr.....</u>	---	---	23,900	CF-12-1
			<u>TOTAL.....</u>	<u>137,530</u>	<u>166,300</u>	<u>195,500</u>	

* \$500K Included in 1987 in R&PM to Begin These Activities

LOCATION OF MAJOR AND COMPONENT INSTALLATIONS



RECORDED VALUE OF CAPITAL TYPE PROPERTY
IN HOUSE AND CONSTRUCTION-HOLD
AS OF SEPTEMBER 30, 1964
(DOLLARS IN THOUSANDS)

REAL PROPERTY

REPORTING INSTALLATION		LAND		BUILDING		OTHER STRUCTURES-EQUIPMENT		AND FACILITIES IMPROVEMENTS		TOTAL		EQUIPMENT		IN PROGRESS		FIXED ASSETS		GRAND TOTAL	
AMES RESEARCH CENTER		2928	345888	27093	0	375829	37177	179618	0	292724	0	0	0	0	0	0	0	292724	0
AMC WOFFETT FIELD, CA		2927	322836	12186	0	337149	861072	172443	0	770664	0	0	0	0	0	0	0	770664	0
ORDRON FLIGHT FACILITY EDWARDS, CA		0	23076	14640	0	37636	83815	7175	0	130626	0	0	0	0	0	0	0	130626	0
VARIOUS LOCATIONS (A)		1	696	347	0	1044	24910	0	0	25954	0	0	0	0	0	0	0	25954	0
CDOORD SPACE FLIGHT CENTER		2857	156849	111547	0	270473	533178	41774	0	845425	0	0	0	0	0	0	0	845425	0
CSCC - GREENWELL, MO		1361	105090	19524	0	125975	260178	34089	0	421042	0	0	0	0	0	0	0	421042	0
TOAKING STATIONS NETWORK		5	12197	26615	0	38817	151151	2544	0	192532	0	0	0	0	0	0	0	192532	0
WFF - WALLONS ISLAND, VA		1491	38592	65407	0	105490	68950	4321	0	178761	0	0	0	0	0	0	0	178761	0
VARIOUS LOCATIONS (A)		0	190	1	0	191	52899	0	0	53090	0	0	0	0	0	0	0	53090	0
JPL PRODUCTION LABORATORY		1188	113595	84573	1893	201249	330463	56189	0	590901	0	0	0	0	0	0	0	590901	0
JPL - PASADENA, CA		1188	101296	16242	1891	120527	266998	56189	0	436814	0	0	0	0	0	0	0	436814	0
DEEP SPACE NETWORK		0	12399	68931	2	80722	73365	0	0	154087	0	0	0	0	0	0	0	154087	0
JOHNSON SPACE CENTER		10889	215849	71282	105	298145	478726	7530	0	776401	0	0	0	0	0	0	0	776401	0
JSC - HOUSTON, TX		7319	178409	43216	0	228944	317665	7530	0	554139	0	0	0	0	0	0	0	554139	0
WHITE SANDS TEST FACILITY LOS CRUCES, NM		0	9836	22495	105	32436	23881	0	0	56317	0	0	0	0	0	0	0	56317	0
VARIOUS LOCATIONS (A)		3570	27624	5571	0	36765	129780	0	0	145945	0	0	0	0	0	0	0	145945	0
XLMEDY SPACE CENTER		71345	455310	522491	0	1049146	745508	79980	0	1894134	0	0	0	0	0	0	0	1894134	0
KSC - CAPE CANAVERAL, FL		71345	455310	522491	0	1049146	745508	79980	0	1334183	0	0	0	0	0	0	0	1334183	0
WESTERN TEST RANGE, LOMPAC, CA		0	0	0	0	0	134262	0	0	134262	0	0	0	0	0	0	0	134262	0
VARIOUS LOCATIONS (A)		0	0	0	0	0	425769	0	0	425769	0	0	0	0	0	0	0	425769	0
LAMP (A) RESEARCH CENTER		162	168841	345882	0	514025	306845	40230	0	861100	0	0	0	0	0	0	0	861100	0
LAMP - HAMPTON, VA		162	168841	345751	0	513974	289663	40230	0	843867	0	0	0	0	0	0	0	843867	0
VARIOUS LOCATIONS (A)		0	0	51	0	51	1782	0	0	1733	0	0	0	0	0	0	0	1733	0
LEWIS RESEARCH CENTER		2621	239927	83453	136	320337	180982	27196	0	536615	0	0	0	0	0	0	0	536615	0
LELC - CLEVELAND, OH		316	157520	64591	136	222563	161441	27196	0	417200	0	0	0	0	0	0	0	417200	0
PLUMBROOK, SANDUSKY, OH		2305	74497	19062	0	97774	3990	0	0	101764	0	0	0	0	0	0	0	101764	0
VARIOUS LOCATIONS (A)		0	0	0	0	0	17651	0	0	17651	0	0	0	0	0	0	0	17651	0
MDSMALL SPACE FLIGHT CENTER		7171	272412	147431	0	427014	404959	0	0	911973	0	0	0	0	0	0	0	911973	0
MSC - HUNTSMILLE, AL		0	131408	64940	0	198340	298821	0	0	497169	0	0	0	0	0	0	0	497169	0
MICHAUD ASSEMBLY FACILITY, AL		7102	130950	67407	0	253459	63394	0	0	268853	0	0	0	0	0	0	0	268853	0
SLIBELL COMPUTER COMPLEX, AL		69	5295	2167	0	8041	8319	0	0	16360	0	0	0	0	0	0	0	16360	0
VARIOUS LOCATIONS (A)		9	4849	19317	0	15166	114425	0	0	129591	0	0	0	0	0	0	0	129591	0
NATIONAL SPACE TECH LABS		18861	28732	194088	0	300882	364723	0	0	337885	0	0	0	0	0	0	0	337885	0
NSTL - NSTL STATION, MS		18861	28732	194088	0	300882	36482	0	0	337744	0	0	0	0	0	0	0	337744	0
VARIOUS LOCATIONS (A)		0	0	0	0	0	61	0	0	61	0	0	0	0	0	0	0	61	0
NASA HEADQUARTERS		0	0	0	0	0	39525	0	0	39525	0	0	0	0	0	0	0	39525	0
NASA HQS, WASH, D C		0	0	0	0	0	19558	0	0	19558	0	0	0	0	0	0	0	19558	0
VARIOUS LOCATIONS (A)		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MCCMC TOTAL		117222	2049784	1587940	2134	3757100	3539506	426517	0	7721123	0	0	0	0	0	0	0	7721123	0

JUSTIFICATION
BY LOCATION

SPACE STATION
FACILITIES

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

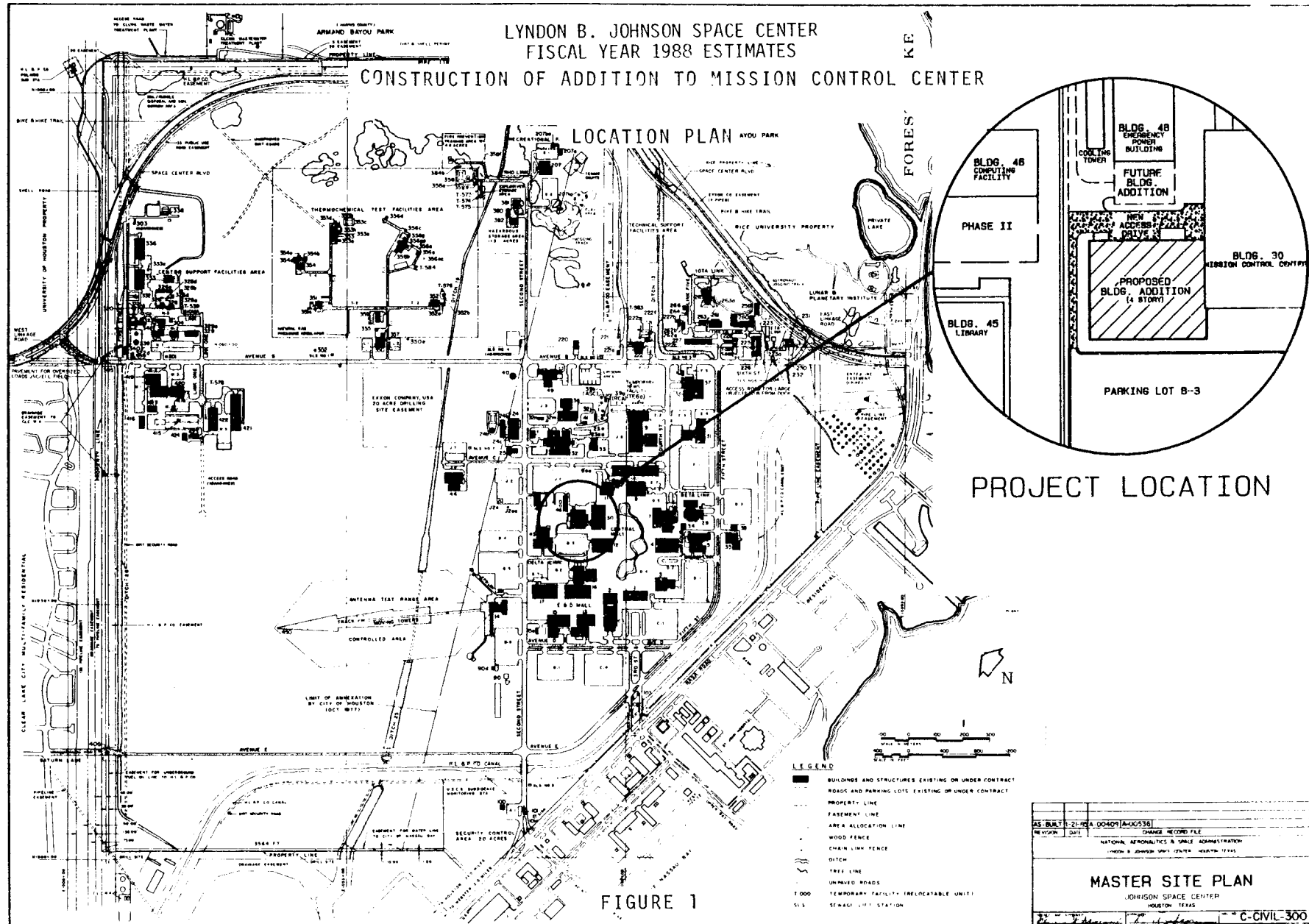
CONSTRUCTION OF FACILITIES

FISCAL YEAR 1988 ESTIMATES

SUMMARY

SPACE STATION FACILITIES

<u>Office of Space Station:</u>	<u>Amount</u>	<u>Page No.</u>
Construction of Addition to Mission Control Center, Johnson Space Center	15,800,000	CF 1-1
Construction of Addition to the Simulator/Training Facility, Johnson Space Center	3,400,000	CF 1-9
Construction of Space Station Processing Facility, Kennedy Space Center	3,600,000	CF 1-17
Modifications of Process Technology Facility for Space Station, Marshall Space Flight Center	<u>3,000,000</u>	CF 1-23
Total,	<u>25,800,000</u>	



CONSTRUCTION OF FACILITIES

FISCAL YEAR 1988 ESTIMATES

PROJECT TITLE:	<u>Construction of Addition to Mission Control Center</u>
INSTALLATION:	<u>Lyndon B. Johnson Space Center</u>
	FY 1988 CoF Estimate: <u>\$15,800,000</u>

LOCATION OF PROJECT: Houston, Harris County, Texas

COGNIZANT HEADQUARTERS OFFICE: Office of Space Station

FY 1987 AND PRIOR YEARS' FUNDING: The following prior years' funding is related to this project:

	<u>Planning and Design</u>	<u>Construction</u>	<u>Total</u>
Specific CoF funding.... ..	\$1,415,000	\$ -0-	\$ 1,415,000
Capitalized investment.....	<u>-0-</u>	<u>12,918,628</u>	<u>12,918,628</u>
Total..... ..	<u>\$1,415,000</u>	<u>\$12,918,628</u>	<u>\$14,333,628</u>

SUMMARY PURPOSE AND SCOPE:

This project provides for a Space Station Support Center (SSSC) by constructing an addition to the Mission Control Center (MCC), Building 30, mission operations wing (MOW), to meet the requirements for continuing on orbit operations support for Space Station. This four-story addition of approximately 88,000 square feet, will provide space to accommodate various ground-based automatic data processing (ADP) equipment systems and associated operations support areas.

PROJECT JUSTIFICATION:

This project is required to provide a Space Station Support Center (SSSC) for both the initial support of the Space Station orbital assembly and mature operations. Beginning with the first element launch, the facility will be required for support of real-time, near-real-time, and follow-on operations management, engineering analysis, contingency planning/operations, and logistics coordination/management for the life of the Space Station Program. The facility must be fully operational approximately 1 year prior to first element launch to support operations procedures simulation and verification. Systems installation, activation, and testing within the completed addition must start 3 years prior to operational readiness.

The Space Station Support Center will be located in the immediate proximity of the existing Mission Control Center (MCC) to allow sharing of common skills, personnel, equipment, communications, and data between the similar operations, engineering, and maintenance tasks for the Space Transportation System (STS) and Space Station programs. The addition is required because all existing and planned facilities will be fully utilized and dedicated to STS operations planned through the 1990s. Even though limited sharing of MCC areas will be possible, the STS requirements, manpower and equipment distribution, and severe security restrictions of the MCC make it basically unsuitable and unavailable for use as the SSSC.

It is anticipated that approximately 30 civil service and 35 contractor personnel per single shift will be required in the SSSC on a 24-hour-per-day basis during routine Space Station operations, and six times this number is anticipated during high-activity periods such as initial assembly and critical phases of platform delivery and module resupply. In addition to the work-station-style operations areas, the addition will house operations support equipment including operations and data base computers, storage, and peripherals; voice and video processing, recording, and archiving; data archiving and retrieval; timing control and display; and basic systems operation and maintenance.

IMPACT OF DELAY:

If this project is not approved, there will not be adequate space at Johnson Space Center to establish and operate the Space Station support center required for program accomplishment. Systems installation/activation and operations procedures development and verification requirements prior to first element launch require this facility to be completed by mid 1989. Space Station operation will be delayed if this facility is not constructed in the FY 1988 program.

PROJECT DESCRIPTION:

This project provides for construction of a four-story addition at the southwest corner of the existing Missions Control (MCC), Building 30 (MOW). The addition will consist of approximately 88,000 square feet for Space Station operations support and data processing/storage. Areas also will be provided for visitor viewing, restrooms, corridors, stairways, elevators, and mechanical room facilities. New construction will essentially match the existing exterior and interior architecture of the MOW. Included in this project will be air-conditioning and heating; fire detection, alarm, and suppression systems; electrical power; and lighting as required for the various areas. Also included will be raised flooring and air-conditioning required by the computing equipment. Various existing underground utilities will be relocated as required and new storm drainage, sanitary sewer, and water lines will be connected to existing site systems to serve the new addition. An existing paved service drive located on the west side of the MOW will be reconfigured for access to the new addition, and a loading dock, pedestrian walkways, and a paved parking area will also be provided.

PROJECT COST ESTIMATE:

The basis of this cost estimate is a preliminary engineering report (PER).

	Unit of Measure	Quantity	Unit cost	cost
<u>Land Acquisition</u>	---	---	---	---
<u>Construction</u>	---	---	---	15,800,000
Site Preparation:.....				1,404,000
15 KV/unit substation.....	LS	1	---	(332,000)
Utilities modifications and relocations.....	LS	1	---	(428,000)
Utility tunnel.....	LS	1	---	(263,000)
Concrete walks and asphalt driveway.....	LS	1	---	(81,000)
Parking lot.....	LS	1	---	(300,000)
Modifications to Existing				
Buildings 30 and 48:.....				338,000
Architectural/structural.....	LS	1	---	(81,000)
Mechanical.....	LS	1	---	(116,000)
Electrical and security.....	LS	1	---	(116,000)
Uninterruptible power.....	LS	1	---	(25,000)
New Addition:.....				14,058,000
Architectural/structural.....	SF	88,000	98.32	(8,652,000)
Mechanical.....	SF	88,000	34.30	(3,018,000)
Electrical.....	SF	88,000	22.70	(1,998,000)
Security.....	LS	1	---	(390,000)
<u>Equipment</u>	---	---	---	---
<u>Fallout Shelter</u> (not feasible).....	---	---	---	---
<u>Total</u>				15,800,000

LIST OF RELATED GRAPHICS:

Figure 1 - Project Location

Figure 2 - Site Plan

Figure 3 - South Elevation

OTHER EQUIPMENT SUMMARY:

Noncollateral equipment such as host computers, front-end processors, software, and work stations, estimated to cost \$71,000,000, will be provided from R&D resources.

FUTURE CoF ESTIMATED FUNDING REQUIRED TO COMPLETE THIS PROJECT:

There will be a future requirement for backup electrical and cooling prior to first element launch. However, these are not required during the activation, simulation, and verification phases.

LYNDON B. JOHNSON SPACE CENTER
FISCAL YEAR 1988 ESTIMATES
CONSTRUCTION OF ADDITION TO MISSION CONTROL CENTER
SITE PLAN

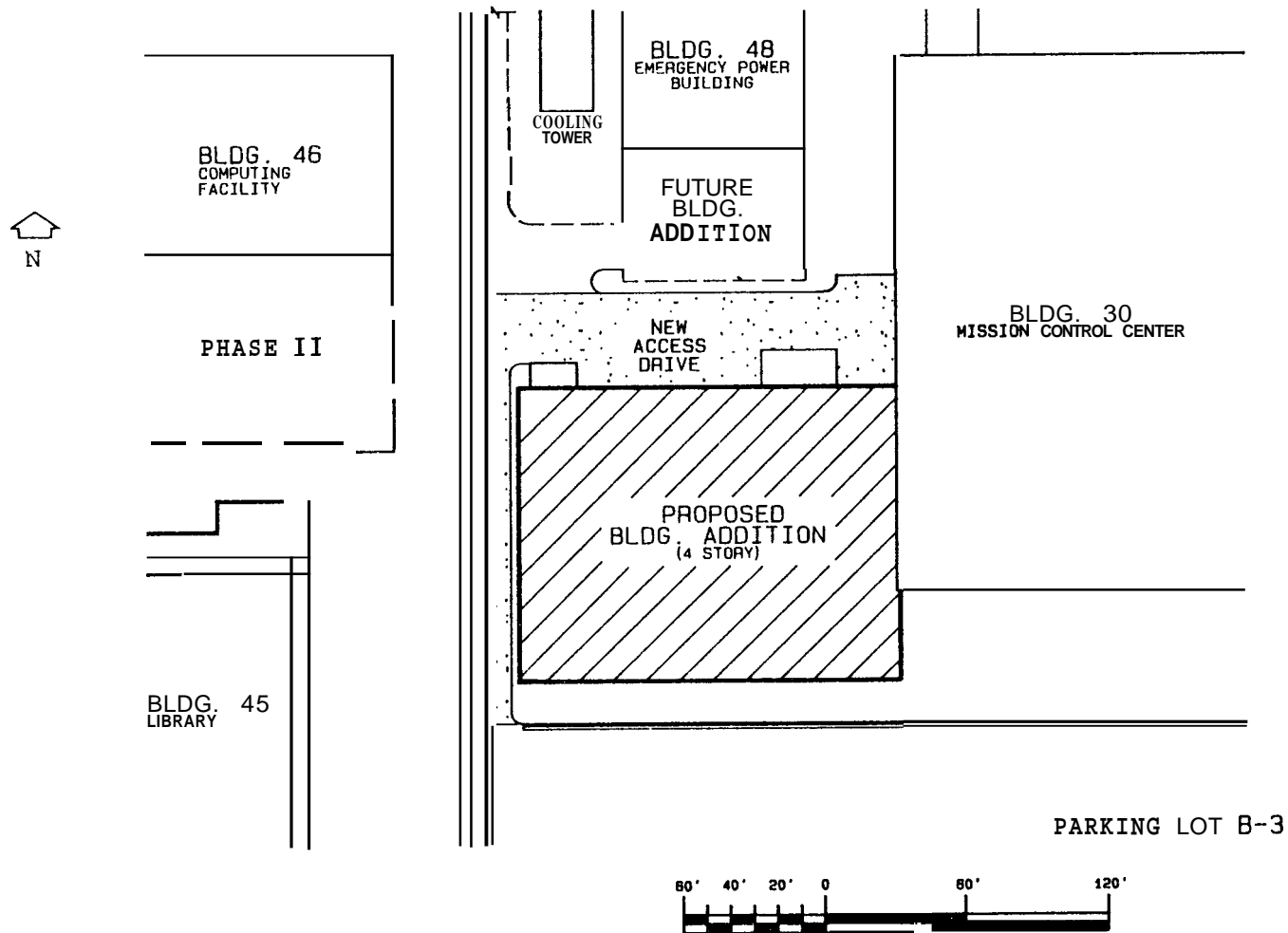


FIGURE 2

LYNDON B. JOHNSON SPACE CENTER
FISCAL YEAR 1988 ESTIMATES
CONSTRUCTION OF ADDITION TO MISSION CONTROL CENTER
SOUTH ELEVATION

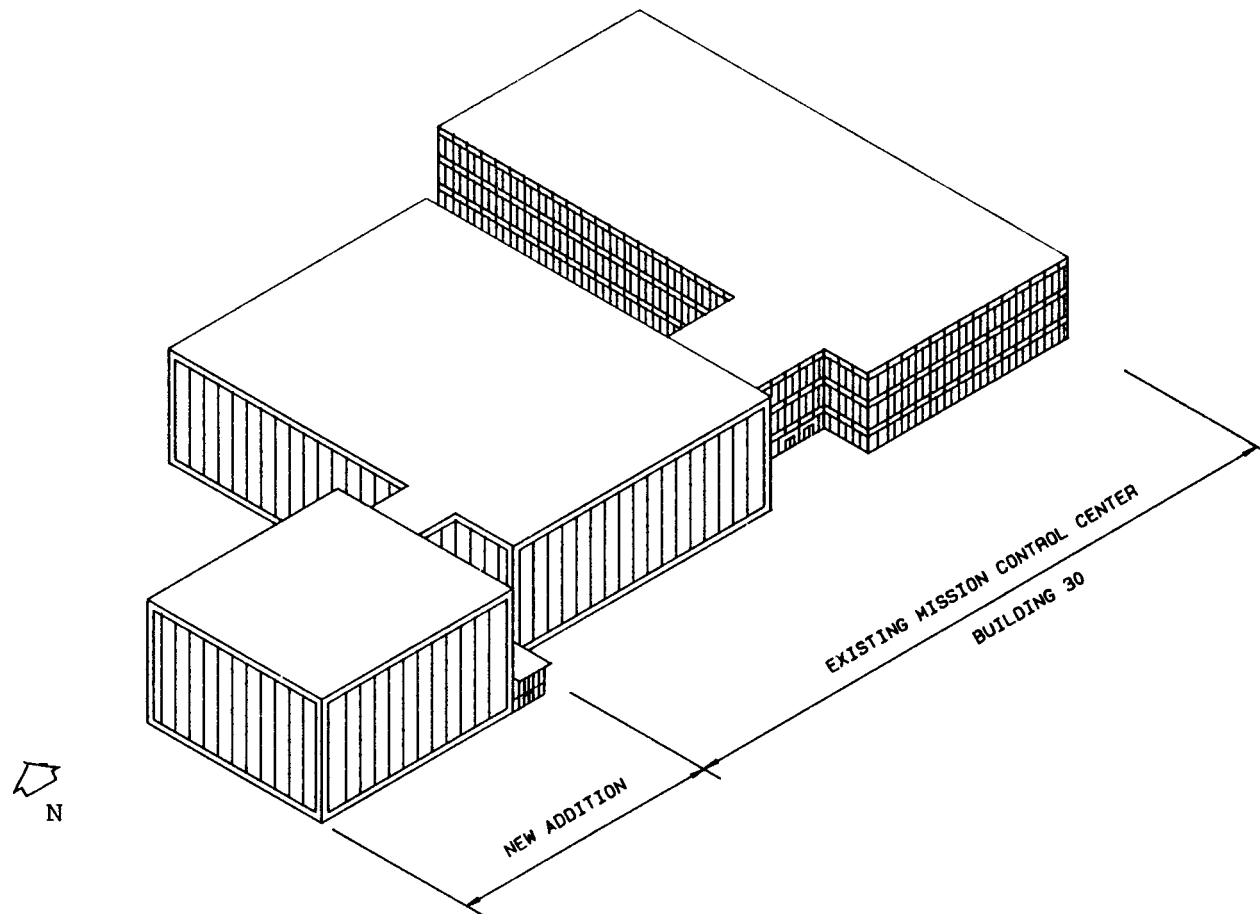


FIGURE 3

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1988 ESTIMATES

PROJECT TITLE:	<u>Construction of Addition to the Simulator/Training Facility</u>
INSTALLATION:	<u>Lyndon B. Johnson Space Center</u>
	FY 1988 CoF Estimate: <u>\$3,400,000</u>

LOCATION OF PROJECT: Houston, Harris County, Texas

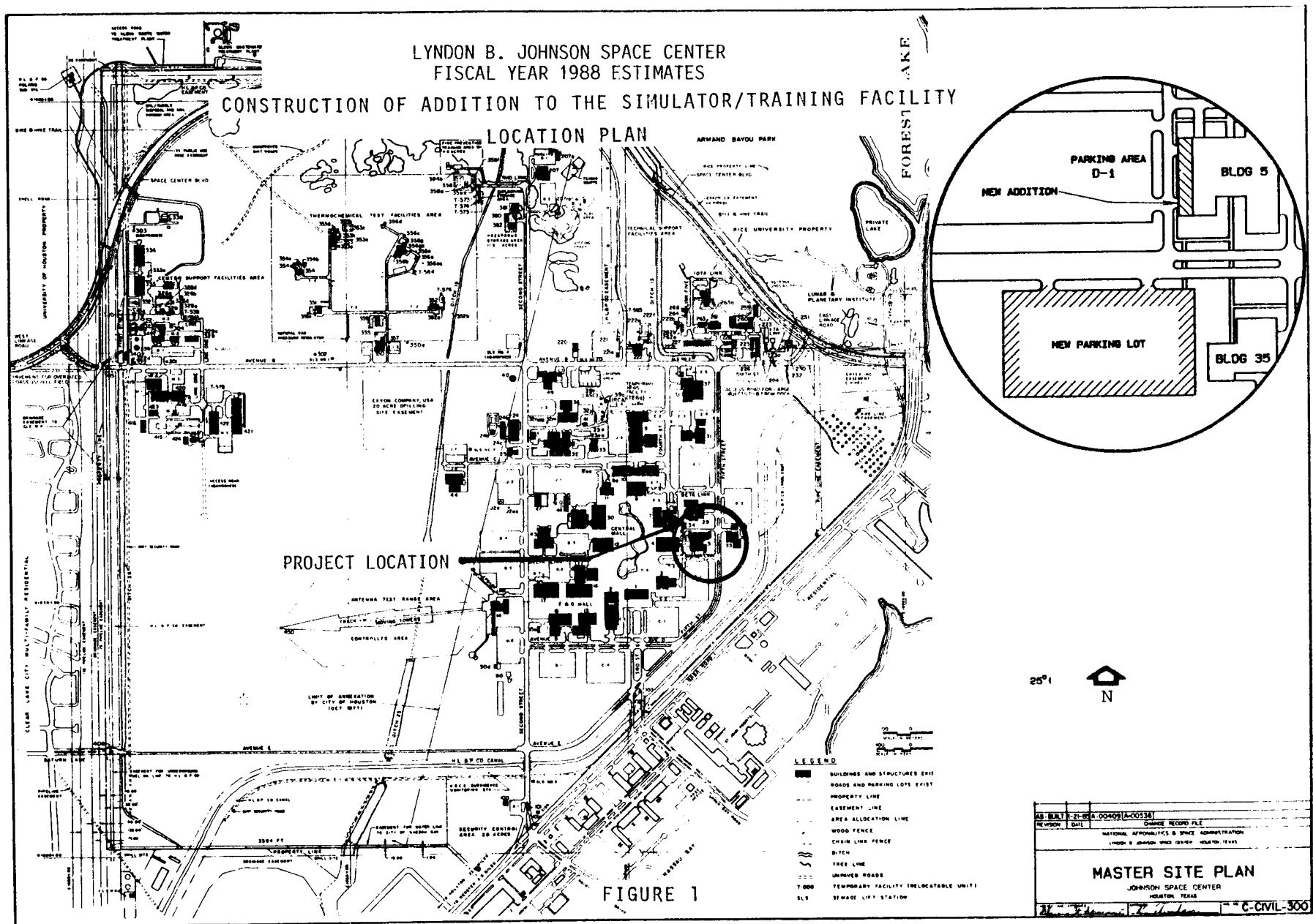
COGNIZANT HEADQUARTERS OFFICE: Office of Space Station

FY 1986 AND PRIOR YEARS' FUNDING: The following prior years' funding is related to this project:

	<u>Planning and Design</u>	<u>Construction</u>	<u>Total</u>
Specific CoF funding.....	\$3 10,000	-0-	\$ 310,000
Capitalized investment.....	<u>-0-</u>	<u>\$3,915,937</u>	<u>3,915,937</u>
Total.....	<u>\$3 10,000</u>	<u>\$3,915,937</u>	<u>\$4,225,937</u>

SUMMARY PURPOSE AND SCOPE:

This project provides for construction of an addition to and modifications within the Mission Simulation and Training Facility, Building 5, to accommodate Space Station simulators/trainers and ancillary support equipment necessary for training of flight crews and ground controllers. The new multi-story addition will add



approximately 22,200 square feet in three floors and will modify the existing high bay by removing existing walls and installing approximately 3,000 square feet of computer flooring.

PROJECT JUSTIFICATION:

This project is required to provide necessary facility space to accommodate the various additional simulators/trainers needed for the Space Station-unique systems. Multiple part-task crew-station trainers with computational and networking support will be required for fully integrated ground/flight Shuttle/Space Station simulation and training to support Space Station operations. These new Space Station-unique trainers and ancillary support equipment cannot be accommodated in the existing Shuttle Mission Simulator (SMS) Complex, Building 5.

The Space Station System Trainers are required for systems such as; power, operations management, communication and tracking, data management, thermal, fluids, propulsion, and environmental control and life support. The crew simulators/trainers are also necessary to provide training for crew skills requiring hand and eye coordination and precise control in areas such as guidance, navigation and control, course pointing systems and berthing/docking.

Operational capability is required 2 years prior to first Space Station element launch to begin crew training and simulation. The first year of this period is for instructor familiarization, procedures development, and crew training for base systems, proximity operations, and ground to Space Station operations. The second year is for coordinate training and simulation in concert with Space Station support center, the distributed Space Station information system and the users in preparation for first element launch.

IMPACT OF DELAY:

If this project is not approved, adequate space cannot be provided for Space Station-unique flight crew and ground-controller training in time to ensure safe and effective Space Station operations. The existing STS facilities will remain fully utilized. Trainer installation and activation requirements for first element launch require this facility work to be completed by early 1989 to permit equipment installation and activation by early 1991. Operation will be delayed by nonavailability of these facilities.

PROJECT DESCRIPTION:

This project provides for the construction of a multistory building addition and for modifications within Building 5. The addition to the south side of the existing south wing high bay will include approximately 22,200 square feet of new floor space. The first floor will comprise approximately 7,400 square feet of which 6,100 square feet will be raised computer flooring. The second floor will comprise approximately 7,400 square feet and will have approximately 6,900 square feet of computer flooring. The third floor will be 7,400 square feet of open storage and supply area. The existing high bay will be modified by the removal of existing walls and the addition of approximately 3,000 square feet of computer flooring to support the tall training simulators. The project work also includes air-conditioning, restrooms, an elevator, stairs, mechanical room, and a closed-loop chilled-water system. Site work related to this project includes the provision of utilities to the addition, modification of storm drainage and landscaping, and the construction of a paved parking area for approximately 100 vehicles. A secure wall with a security entrance will be provided between the existing high bay and the existing secure area of Building 5.

PROJECT COST ESTIMATE:

The basis of this cost estimate is a preliminary engineering report (PER).

	<u>Unit of Measure</u>	<u>Quantity</u>	<u>Unit cost</u>	<u>cost</u>
<u>Land Acquisition</u>	---	---	---	---
<u>Construction</u>	---	---	---	<u>3,400,000</u>
Site Preparation:				603,000
Utilities modifications and relocations	LS	1	---	(130,000)
Paved parking lot	LS	1	---	(300,000)
Electric switches and unit substation	LS	1	---	(173,000)
Modifications to Existing Building 5:				409,000
Architectural and structural	LS	1	---	(142,000)
Mechanical	LS	1	---	(100,000)
Electrical	LS	1	---	(110,000)
Raised access floor	SF	3,000	18.87	(57,000)
New Building Addition:				2,388,000
Elevator	LS	1	---	(97,000)
Raised access floor	SF	13,000	18.87	(245,000)
Architectural/structural	SF	22,200	25.81	(573,000)
Mechanical	SF	22,200	44.24	(982,000)
Electrical	SF	22,200	22.12	(491,000)
<u>Equipment</u>	---	---	---	---
<u>Fallout Shelter (not feasible)</u>	---	---	---	---
<u>Total</u>				<u><u>3,400,000</u></u>

LIST OF RELATED GRAPHICS:

Figure 1 - Project Location
Figure 2 - Site Plan
Figure 3 - Floor Plan

OTHER EQUIPMENT SUMMARY:

Noncollateral equipment such as Space Station simulators and trainers estimated to cost \$50,500,000, will be provided from R&D resources.

FUTURE CoF FUNDING REQUIRED TO COMPLETE THIS PROJECT:

No future CoF funding will be required to complete this project.

LYNDON B. JOHNSON SPACE CENTER
FISCAL YEAR 1988 ESTIMATES
CONSTRUCTION OF ADDITION TO THE SIMULATOR/TRAINING FACILITY
SITE PLAN

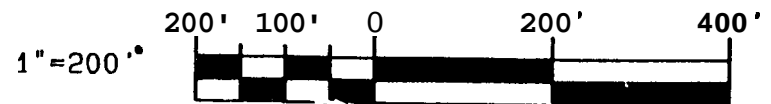
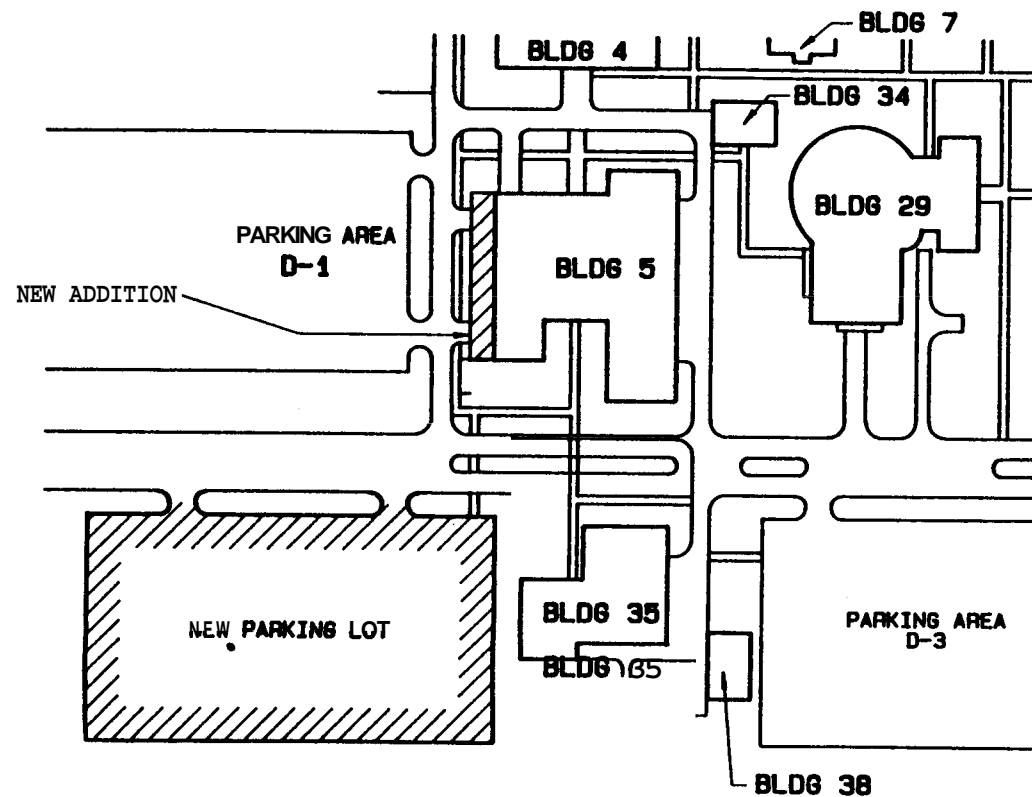


FIGURE 2

LYNDON B. JOHNSON SPACE CENTER
FISCAL YEAR 1988

CONSTRUCTION OF ADDITION TO THE SIMULATOR/TRAINING FACILITY
FLOOR PLAN

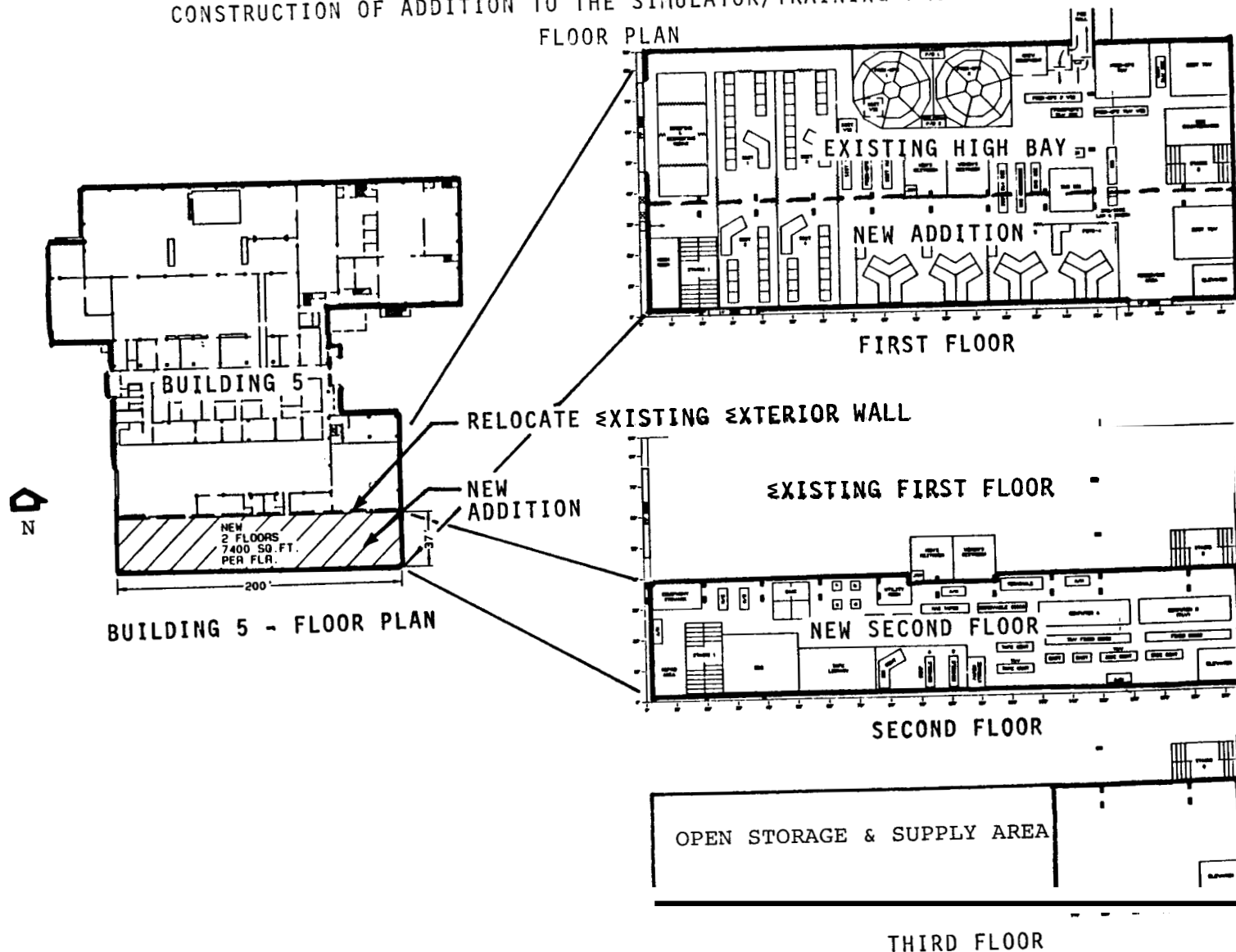


FIGURE 3

JOHN F. KENNEDY SPACE CENTER
FISCAL YEAR 1988 ESTIMATES
CONSTRUCTION OF SPACE STATION PROCESSING FACILITY

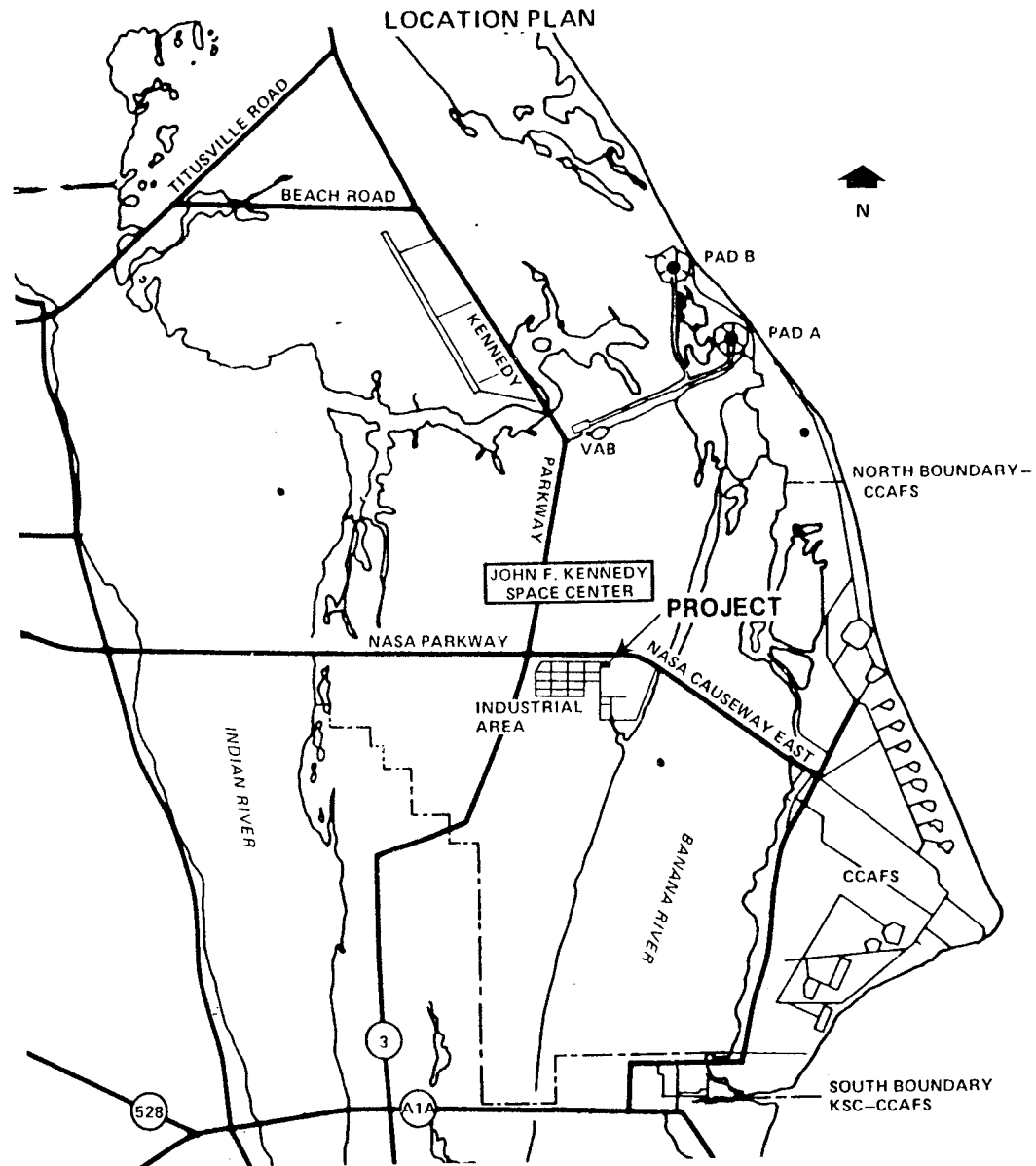


FIGURE 1

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1988 ESTIMATES

PROJECT TITLE:	Construction of Space Station Processing Facility
INSTALLATION:	John F. Kennedy Space Center
FY 1988 CoF Estimate: \$3,600,000	

LOCATION OF PROJECT: Merritt Island, Brevard County, Florida

COGNIZANT HEADQUARTERS OFFICE: Office of Space Station

FY 1987 AND PRIOR YEARS' FUNDING: The following prior years' funding is related to this project:

	<u>Planning and Design</u>	<u>Construction</u>	<u>Total</u>
Specific CoF funding.. ..	\$388,000	---	\$388,000
Capitalized investment.....	---	---	---
Total.....	<u>\$388,000</u>	<u>---</u>	<u>\$388,000</u>

SUMMARY PURPOSE AND SCOPE:

This project is the first increment of a multiyear funded (FY 1988, 1989, 1990) project for construction of a Space Station Processing Facility (SSPF), necessary to provide for non-hazardous prelaunch processing and resupply of the various Space Station elements at the Kennedy Space Center. This FY 1988 phase provides only for SSPF site development, utility construction and tie-in to existing utility and support systems.

PROJECT JUSTIFICATION:

Prelaunch and post-landing processing for technical operations, periodic resupply, and maintenance of Space Station elements, including the co-orbiting platforms and attached payloads, will occur at the KSC. After extensive studies, existing facilities with the potential for supporting this type of prelaunch processing were determined to be inadequate for the processing required for the Space Station elements. Existing processing facilities at KSC are too small and are committed to other uses. Therefore, construction of a new facility to support Space Station payloads is required.

Space Station elements, including the pressurized laboratory, habitation, and logistics modules, power system, structural members, and ancillary systems, will be delivered to KSC. Necessary functions required prior to launch will be performed in this facility. These functions include receiving and acceptance inspection, final assembly, servicing, and close out. In addition, support of ongoing Space Station operations will require logistical and resupply support which will also occur in this facility. This support will consist of logistics module unloading, servicing, and resupply. Staging, materials handling, processing, and storage functions to facilitate these support activities will also be required. The facility will receive other modules and elements returned from the Space Station as a part of the process of periodic resupply, technical outfitting, or upgrading of the Space Station. Certain laboratory and other technical areas will be required to provide final prelaunch and post landing processing activities.

IMPACT OF DELAY:

The launch of the first elements of the Space Station is scheduled for 1993, and prelaunch processing must begin 1 year prior to first element launch. In order to provide an operational facility in this timeframe, construction of the site improvements must begin in 1988. Any delay in this construction will jeopardize the overall Space Station program schedule.

PROJECT DESCRIPTION:

The SSPF total construction project will feature a large high bay and intermediate bay floor operational areas for parallel processing of six (6) SS elements with growth potential to accommodate ten (10) elements in a class 100,000 clean room environment. The FY 1988 increment consists of site clearing, fill, grading, and supporting utilities. Storm drains also will be built and pipelines constructed for ~~CN2~~ and other support systems. Sanitary sewers, firex, and potable water systems will be installed and tied into existing systems. Over 10,000 linear feet of power and communications ductbanks and manholes, and a 2,500 KVA

substation will be provided. This increment will be limited to site preparations and utility work. Other increments will provide the building including assembly and test areas, an airlock, low bay laboratory and payload staging area adjacent to the assembly and test area, and conference, control, documentation, and shop supervision rooms. Limited parking areas and access roads will also be constructed. The final increment will complete the facility interior, access roads, and parking.

PROJECT COST ESTIMATE:

The basis of this cost estimate is a preliminary engineering report (PER).

	<u>Unit of Measure</u>	<u>Quantity</u>	<u>Unit cost</u>	<u>cost</u>
<u>Land Acquisition</u>	---	---	---	---
<u>Construction</u>	---	---	---	<u>3,600,000</u>
Site development				935,000
Clear, grub and demuck site	Acres	27	6,592.59	(178,000)
Fill and grading	CY	172,000	4.40	(757,000)
Water, drainage, and sanitary sewer systems	LS	---	---	388,000
Electrical	---	---	---	2,277,000
Unit substation 2500 KVA	EA	I	288,000	(288,000)
Power ductbank	LF	5,400	69.44	(375,000)
Communications ductbank	LF	5,500	130.55	(718,000)
500 MCM 15 KV cable	LF	33,000	18.24	(602,000)
Miscellaneous electrical equipment	LS	---	---	(294,000)
<u>Equipment</u>	---	---	---	---
<u>Fallout Shelter (not feasible)</u>	---	---	---	---
Total				<u>3,600,000</u>

LIST OF RELATED GRAPHICS:

Figure 1 - Location Plan

Figure 2 - Site Preparation and Utilities Plan

OTHER EQUIPMENT SUMMARY:

No noncollateral equipment is required for this increment.

FUTURE CoF ESTIMATED FUNDING REQUIRED TO COMPLETE THIS PROJECT:

Additional funding of approximately \$60 million will be required in subsequent years for the SSPF and other support facilities.

**JOHN F. KENNEDY SPACE CENTER
FISCAL YEAR 1988 ESTIMATES
CONSTRUCTION OF SPACE STATION PROCESSING FACILITY
SITE PREPARATION AND UTILITIES PLAN**

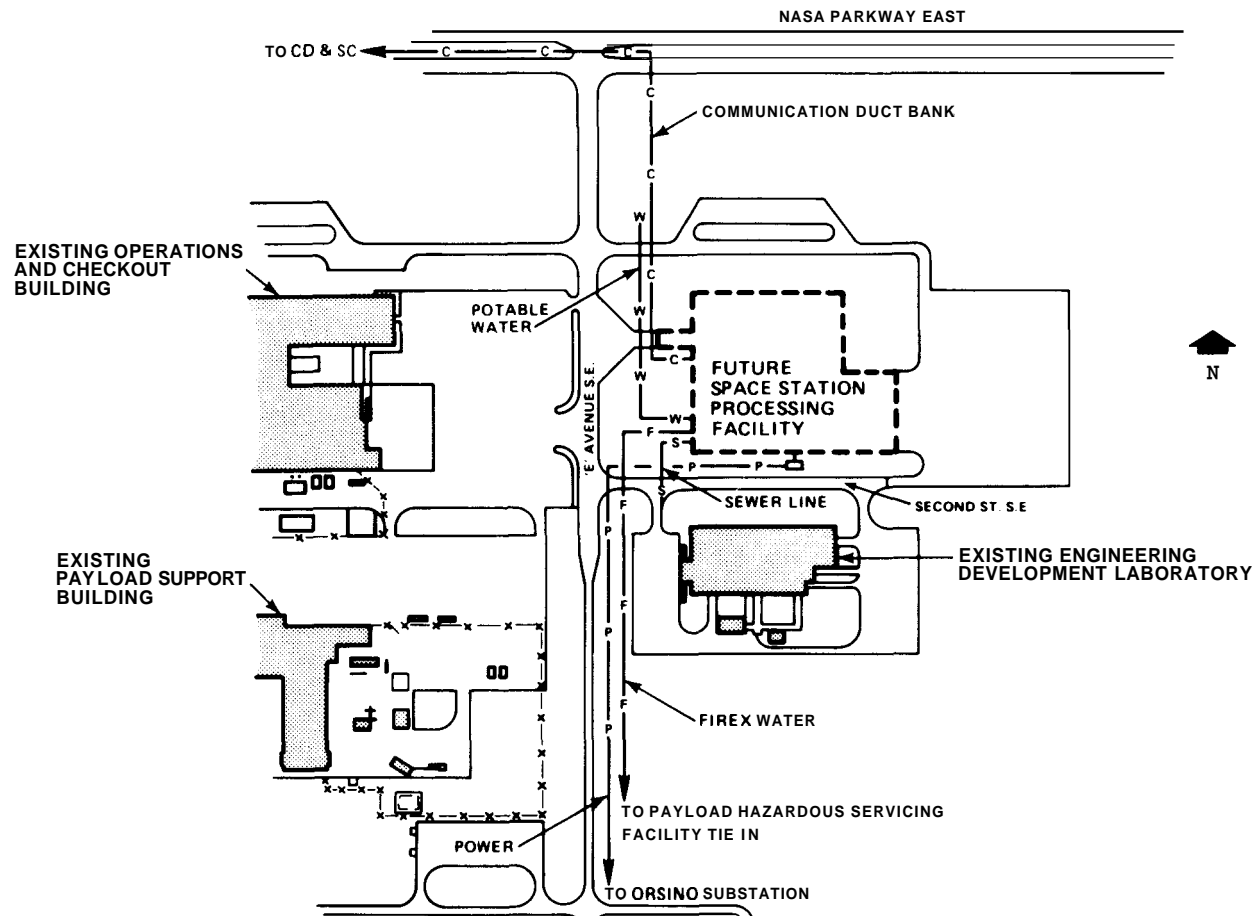


FIGURE 2

MARSHALL SPACE FLIGHT CENTER
FISCAL YEAR 1988 ESTIMATES
MODIFICATIONS OF PROCESS TECHNOLOGY FACILITY FOR SPACE STATION

LOCATION PLAN

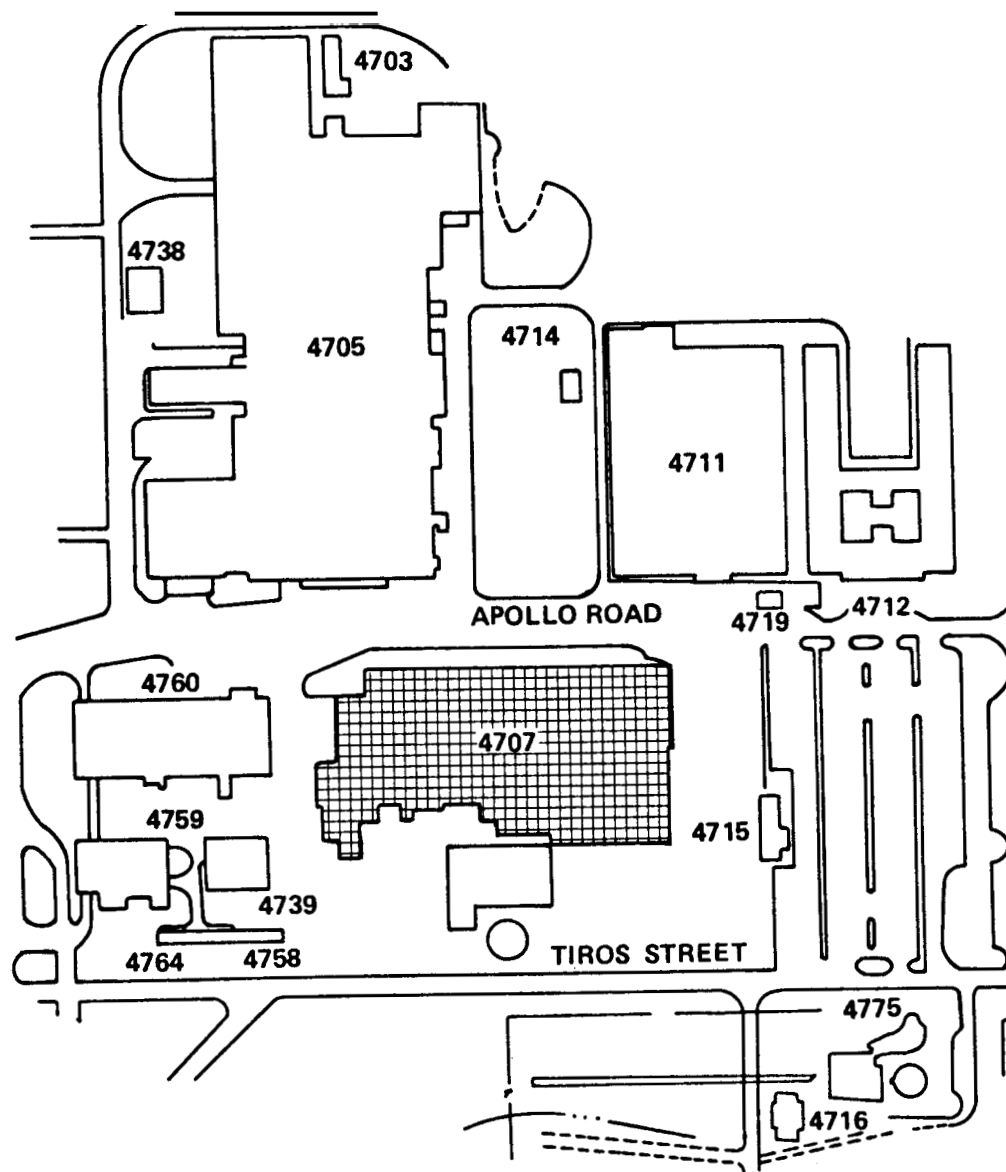


FIGURE 1

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1988 ESTIMATES

PROJECT TITLE:	Modifications of Process Technology Facility for Space Station
INSTALLATION:	George C. Marshall Space Flight Center
	FY 1988 CoF Estimate: <u>\$3,000,000</u>

LOCATION OF PROJECT: Marshall Space Flight Center, Madison County, Alabama

COGNIZANT HEADQUARTERS OFFICE: Office of Space Station

FY 1987 AND PRIOR YEARS' FUNDING: The following prior years' funding is related to this project:

	<u>Planning and Design</u>	<u>Construction</u>	<u>Total</u>
Specific CoF funding.....	\$280,000	N/A	\$ 280,000
Capitalized investment.....	<u>N/A</u>	<u>\$4,660,000</u>	<u>4,660,000</u>
<u>Total.....</u>	<u>\$280,000</u>	<u>\$4,660,000</u>	<u>\$4,940,000</u>

SUMMARY PURPOSE AND SCOPE:

This project provides for the modification of the Process Technology Facility, Building 4707, for the development of new productivity techniques for Space Station common module fabrication and on-orbit repair techniques. The manned Space Station is expected to remain in orbit for many years and on-orbit repair of damaged hardware will be mandatory for safe habitation. This requires the development of special equipment, tools, materials, and techniques in a simulated vacuum environment to measure the effectiveness of each application for space utilization. A 15-foot by 10-foot diameter walk-in vacuum chamber, laser development, robotic water jet, and weld and tool development areas will be provided for potential space assembly processing and repair activities.

PROJECT JUSTIFICATION:

The manned Space Station is expected to remain productive for many years and will require on-orbit repair to damaged hardware. The ability to conduct on-orbit repairs to the Space Station modules as they sustain structural damage or require refurbishment of sealants and surface coatings enhances the longevity and successful operation of the Space Station. Development of the required special repair equipment must include testing in a simulated vacuum environment. Robotized electron beam welding, cutting, soldering, and metal spray coating will be developed and demonstrated. Means of managing generated debris will be studied, with efficiency, reliability and compactness of the repair equipment optimized.

The vacuum chamber is also needed to develop on-orbit bonding and sealing techniques including sealants, adhesives, and coatings for Space Station module repair and refurbishment work. Candidate materials will be tested for outgassing, flammability, toxicity, bonding strength, and sealing efficiency. A laser will be used for the development of ground operations and on-orbit applications including welding, cutting, energy source, precision alignment of large structures, non-destructive testing, and leak detection. The water knife laboratory will provide the capability for development of manufacturing processes with computerized robotic high-pressure water jet cutting of high strength metals and advanced composites to reduce the weight of space structures and launch vehicles.

IMPACT OF DELAY:

Delay of the project will mean that new productivity techniques will not be accomplished in time to support the development of required special equipment needed for the fabrication of the Space Station and could affect the longevity and safety of Space Station operations.

PROJECT DESCRIPTION:

This project modifies and upgrades the Process Technology Facility, Building 4707 (Figure 1). Work includes the modification of approximately 2,000 square feet of space with the installation of a 15-foot by 10-foot-diameter Space Environment Vacuum Chamber (Figure 2), with a clean room, control room, and instrumentation. This includes an addition of 1,500 square feet of space for vacuum pumps and related mechanical equipment. A laser and welding development laboratory of 4,350 square feet will be provided. Work also includes an addition to the building of 1,050 square feet of steel frame and roof construction for a robotic water jet Laboratory. Building modifications will include partitions, lighting, electrical power, air-conditioning, and mechanical equipment for related laboratory and shops.

PROJECT COST ESTIMATE:

This cost estimate is based on a preliminary engineering report.

	<u>Unit of Measure</u>	<u>Quantity</u>	<u>Unit cost</u>	<u>cost</u>
<u>Land Acquisition..</u>	---	---	---	<u>---</u>
<u>Construction.....</u>	---	---	---	<u>3,000,000</u>
Space environment vacuum.....	LS	---	---	2,300,000
chamber (15-foot by 10-foot) and clean room				
Mechanical equipment room.....	SF	1,500	96.97	145,000
Laser and welding laboratory	SF	4,350	32.00	140,000
Robotic water jet laboratory	SF	1,050	128.76	135,000
Building modifications.....	LS	---	---	280,000
<u>Equipment.</u>	---	---	---	<u>---</u>
<u>Fallout shelter (not feasible).....</u>	---	---	---	<u>---</u>
<u>Total.....</u>				<u><u>3,000,000</u></u>

LIST OF RELATED GRAPHICS:

Figure 1 - Location Plan

Figure 2 - Space Environment Vacuum Chamber

OTHER EQUIPMENT SUMMARY:

Welding and tool development equipment of ly \$1 will be provided from R&D funds

FUTURE CoF FUNDING REQUIRED TO COMPLETE THIS PROJECT:

No future CoF resources are required to complete the present scope of this project, however, additional modifications to the Process Technology Facility may be required to support additional new Space Station requirements.

MARSHALL SPACE FLIGHT CENTER
FISCAL YEAR 1988 ESTIMATES
MODIFICATIONS OF PROCESS TECHNOLOGY FACILITY FOR SPACE STATION
SPACE ENVIRONMENT VACUUM CHAMBER

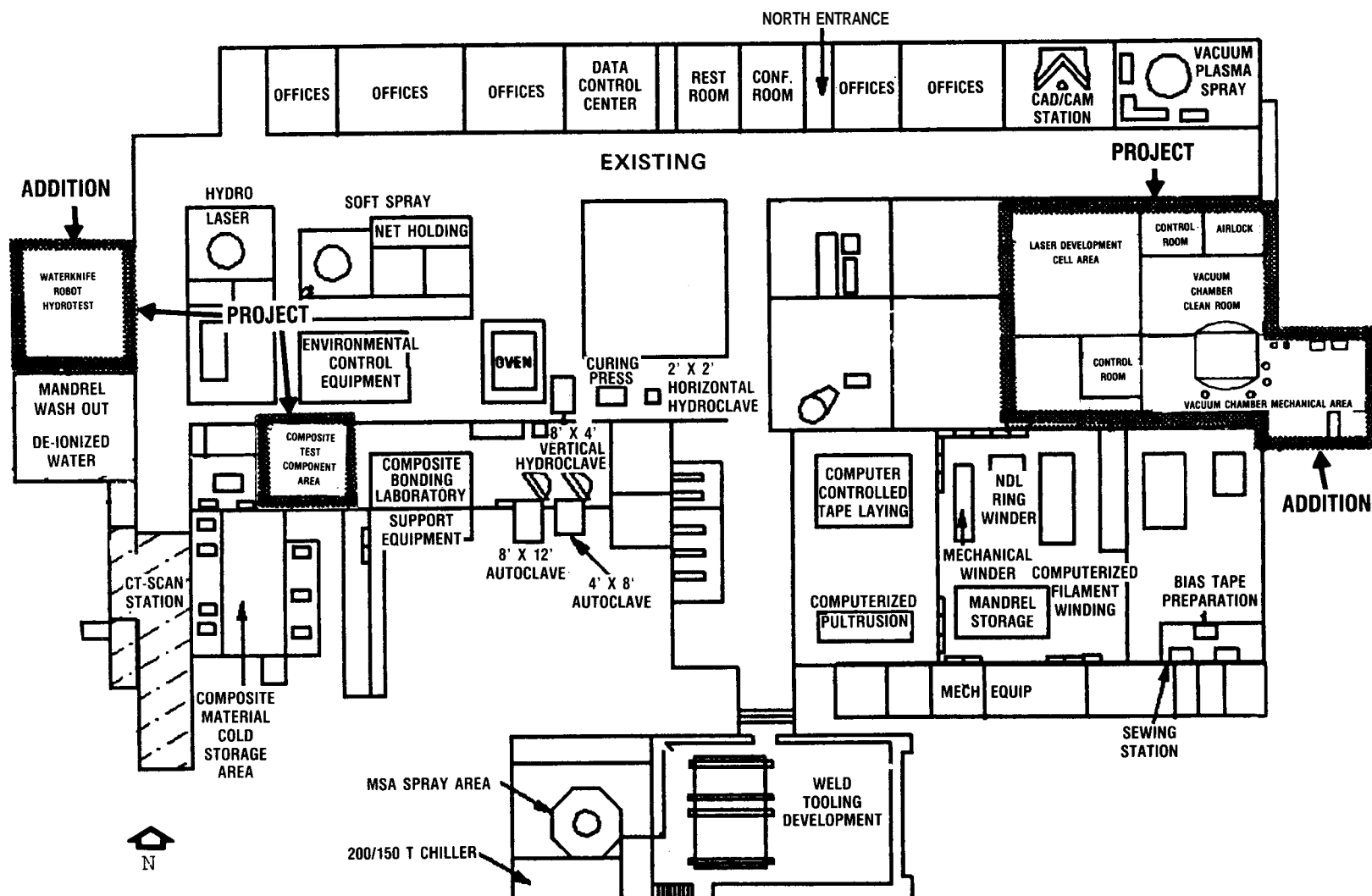


FIGURE 2

SPACE FLIGHT
FACILITIES

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1988 ESTIMATES

SUMMARY

SPACE FLIGHT FACILITIES

<u>Office of Space Flight:</u>	<u>Amount</u>	<u>Page No</u>
Construction of LC 39 Operations Support Building, Kennedy Space Center.....	<u>17,000,000</u>	CF 2-1

JOHN F. KENNEDY SPACE CENTER
FISCAL YEAR 1988 ESTIMATES
CONSTRUCTION OF LC-39 OPERATIONS SUPPORT BUILDING

LOCATION PLAN

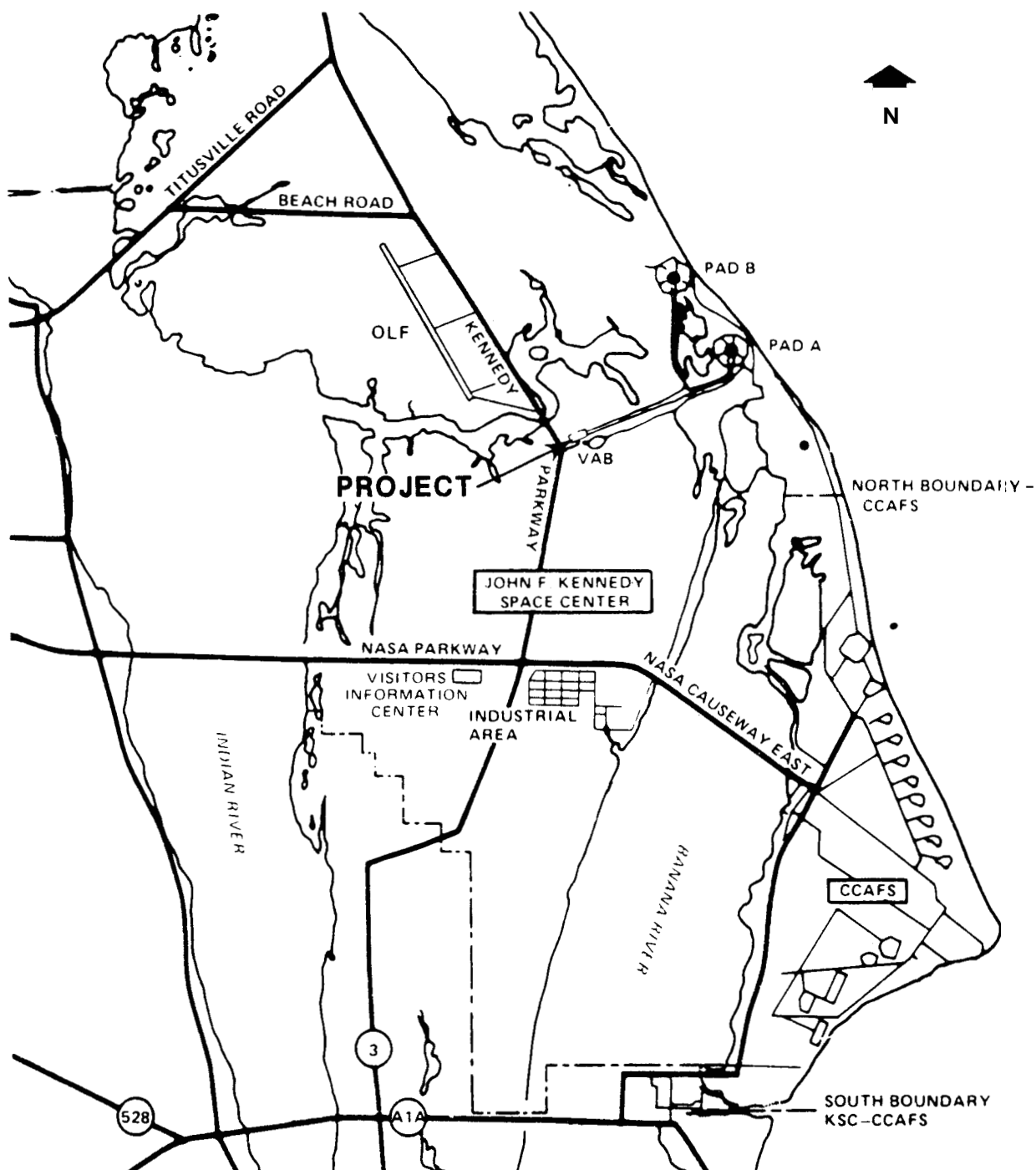


FIGURE 1

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1988 ESTIMATES

PROJECT TITLE:	Construction of LC 39 Operations Support Building
INSTALLATION:	John F. Kennedy Space Center, Florida
	FY 1988 CoF Estimate: \$17,000,000

LOCATION OF PROJECT: John F. Kennedy Space Center, Florida

COGNIZANT HEADQUARTERS OFFICE: Office of Space Flight

FY 1987 AND PRIOR YEARS' FUNDING: The following prior years' funding is related to this project:

	<u>Planning and Design</u>	<u>Construction</u>	<u>Total</u>
Specific CoF funding.....	\$1,355,000	0	\$1,355,000
Capitalized investment.....	0	0	0
Total.....	<u>\$1,355,000</u>	<u>0</u>	<u>\$1,355,000</u>

SUMMARY PURPOSE AND SCOPE:

This project will provide permanent office facilities for Shuttle support personnel currently in temporary relocatable housing in the Vehicle Assembly Building (VAB) area. The building will provide office space for approximately 1,550 civil service and contractor personnel, and improve morale, efficiency, and save considerable maintenance and replacement costs associated with the temporary housing.

PROJECT JUSTIFICATION:

This facility is necessary to provide permanent space for civil service and contractor personnel who were displaced from the VAB due to the safety hazards associated with Solid Rocket Booster (SRB) stacking and integration operations. These people are required to be housed in the immediate vicinity of the Shuttle assembly area because of the nature of the work being performed. The permanent office space for these operational personnel is severely limited and approximately 55 percent of this space is currently provided in temporary housing such as trailers, and relocatable office structures in the immediate vicinity of the VAB. Presently, 1,950 personnel are housed in temporary office facilities near the VAB.

This new facility will concentrate necessary Shuttle processing support personnel in an adequate and safe area convenient to the Shuttle assembly areas. Morale and efficiency will improve and adverse weather will no longer affect personnel work performance or be a threat to the building as is the case with the existing temporary relocatable structures.

Another important benefit of the permanent facility is the significantly lower operation and maintenance cost as compared to the existing temporary housing. The savings in FY 1990 is estimated to be in excess of \$800,000 per year and will escalate thereafter. Because trailers have a short life cycle, additional savings will be realized by avoiding future temporary housing replacement costs.

IMPACT OF DELAY:

Deferral will result in continued inefficiencies and morale problems due to use of the temporary facilities which adversely affect the planned program flight objectives.

PROJECT DESCRIPTION:

This project provides for the construction of an approximately 188,000-square-foot, five-story, concrete and steel building. The building is to be located in the VAB area adjacent to the recently constructed Multifunction Facility (K6-1145). The project site development will provide utilities and parking for the new building and also include the demolition/relocation of the existing small buildings on the site including the Security Patrol Headquarters (K6-1148), Electrical Shop (K6-1195), and Temporary TPS Building (K6-1095); and the construction of a replacement 12,000-square-foot security facility at a nearby site.

The new building will contain office space, and supporting areas for conferences, reproduction, and concessions. The floor space will basically be large, open areas with space-efficient systems furniture providing the required degree of privacy.

PROJECT COST ESTIMATE:

This cost estimate is based on a preliminary engineering report.

	Unit of Measure	Quantity	Unit cost	cost
<u>Land Acquisition.....</u>	---	---	---	---
<u>Construction.....</u>	---	---	---	---
Site development.....	---	---	---	2,600,000
Demolition of temporary buildings and pavement.... ..	SF	40,800	5.66	(231,000)
Relocation/construction of security patrol facility and site work.....	SF	12,000	74.16	(890,000)
Excavation, fill and grading..... ..	CY	26,400	12.99	(343,000)
Drainage and sanitary sewers, potable and fire water systems.	LS	---	---	(209,000)
Parking and associated paving.	SY	10,300	22.72	(234,000)
Electrical transformers, ductbanks, and area lighting... ..	LS	---	---	(650,000)
Sodding and miscellaneous site work.....	LS	---	---	(43,000)
Building structural.....	SF	188,000	18.62	3,500,000
Building architectural.....	SF	188,000	32.98	6,200,000
Building mechanical.....	SF	188,000	13.83	2,600,000
Building electrical.....	SF	188,000	11.17	2,100,000
<u>Equipment.</u>	---	---	---	---
<u>Fallout Shelter (not feasible)</u>	---	---	---	---
<u>Total.....</u>				<u>17,000,000</u>

LIST OF RELATED GRAPHICS:

Figure 1 - Location Plan
Figure 2 - Site Plan
Figure 3 - Perspective

OTHER EQUIPMENT SUMMARY:

Noncollateral equipment such as systems furniture, other furnishings, and equipment for special-purpose areas will be required and costs approximately \$5,500,000.

FUTURE CoF ESTIMATED FUNDING REQUIRED TO COMPLETE THIS PROJECT:

Construction of additional office space will be considered in the development of future CoF budget requests.

JOHN F. KENNEDY SPACE CENTER
FISCAL YEAR 1988 ESTIMATES
CONSTRUCTION OF LC-39 OPERATIONS SUPPORT BUILDING

SITE PLAN

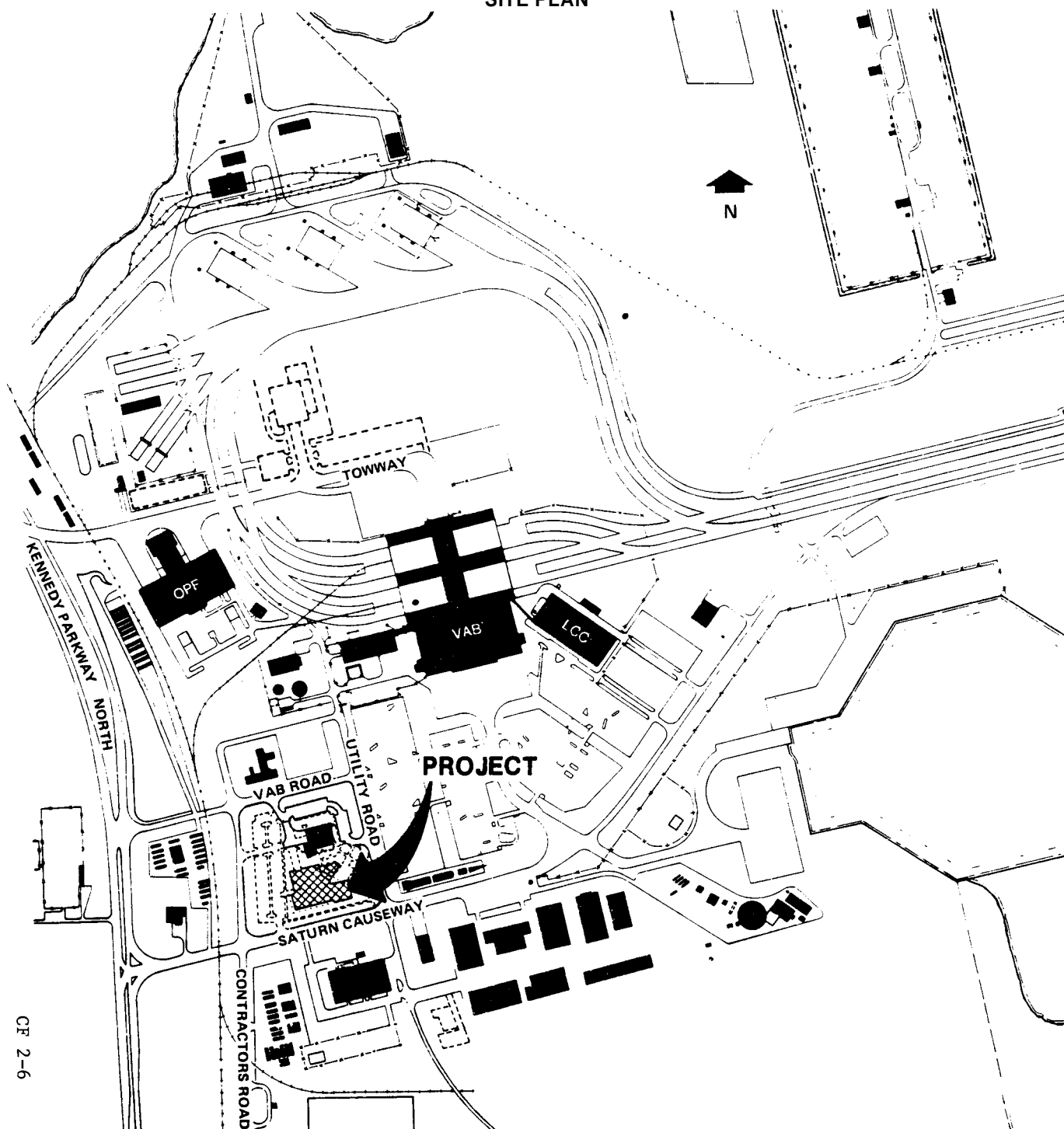


FIGURE 2

JOHN F. KENNEDY SPACE CENTER
FISCAL YEAR 1988 ESTIMATES
CONSTRUCTION OF LC-39 OPERATIONS SUPPORT BUILDING
PERSPECTIVE

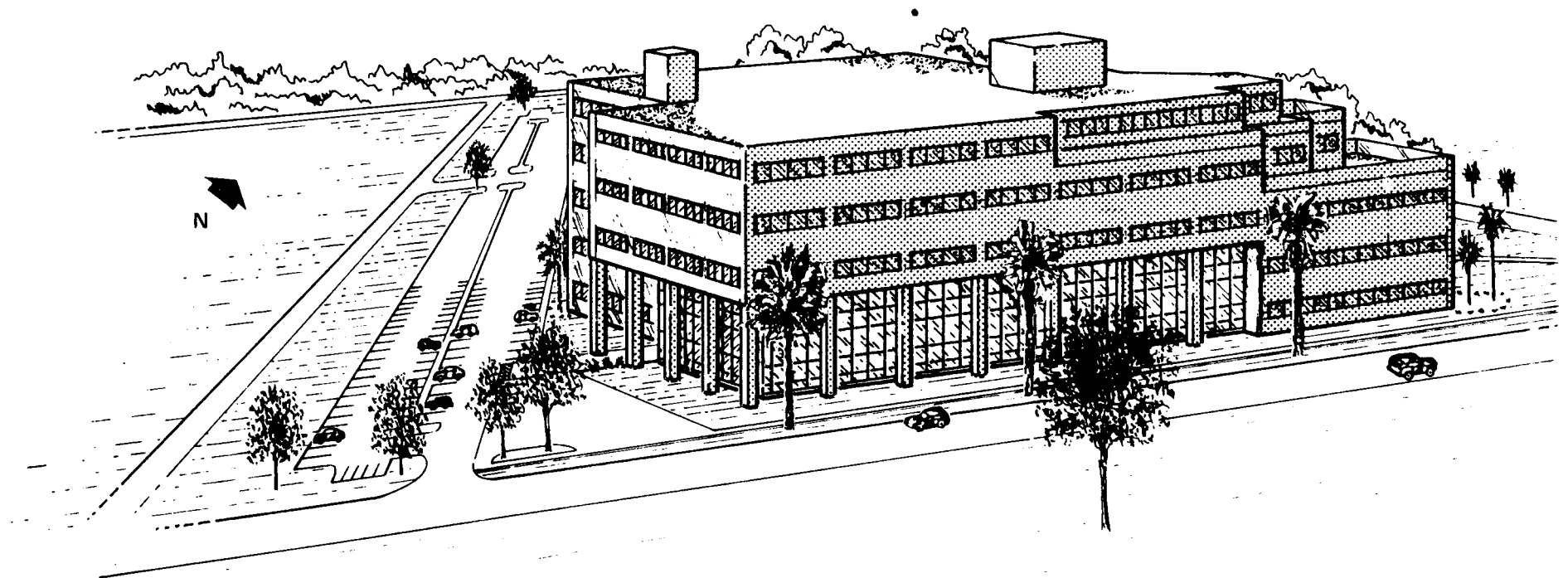


FIGURE 3

GODDARD
SPACE FLIGHT CENTER

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1988 ESTIMATES

SUMMARY

GODDARD SPACE FLIGHT CENTER

<u>Office of Space Science and Applications:</u>	<u>Amount</u>	<u>Page No.</u>
Construction of Spacecraft Systems Development and Integration Facility.....	8,600,000	CF 3-1
Modifications for Utility Reliability	<u>2,900,000</u>	CF 3-9
<u>Tal.....</u>	<u>11,500,000</u>	

GODDARD SPACE FLIGHT CENTER
FISCAL YEAR 1988 ESTIMATES
CONSTRUCTION OF SPACECRAFT SYSTEMS DEVELOPMENT AND INTEGRATION FACILITY
LOCATION PLAN

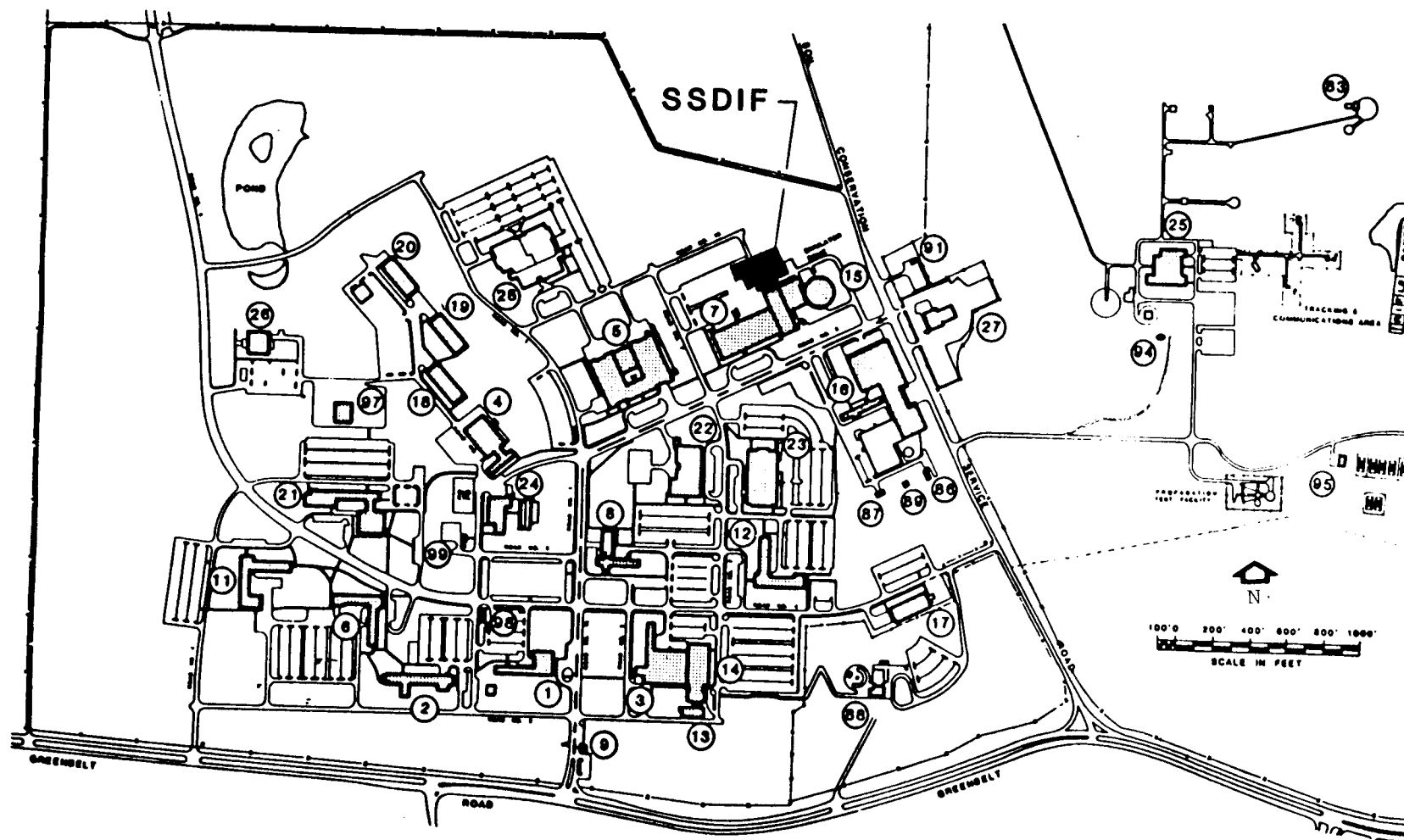


FIGURE 1

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1988 ESTIMATES

PROJECT TITLE:	<u>Construction of Spacecraft Systems Development and Integration Facility</u>
INSTALLATION:	<u>Goddard Space Flight Center</u>
	FY 1988 CoF Estimate: <u>\$8,600,000</u>

LOCATION OF PROJECT: Greenbelt, Prince George's County, Maryland

COGNIZANT HEADQUARTERS OFFICE: Office of Space Science and Applications

FY 1987 AND PRIOR YEARS' FUNDING: The following prior years' funding is related to this project:

	<u>Planning and Design</u>	<u>Construction</u>	<u>Total</u>
Specific CoF funding	\$1,100,000	\$ ---	\$1,100,000
Capitalized investment	<u>N/A</u>	<u>8,000,000</u>	<u>8,000,000</u>
Total	<u>\$1,100,000</u>	<u>\$8,000,000</u>	<u>\$9,100,000</u>

SUMMARY PURPOSE AND SCOPE:

This project provides the second and final increment of funding for an addition to the Building 7/10/15 complex to provide a Spacecraft Systems Development and Integration Facility. This facility is essential to meet impending programmatic needs such as satellite servicing, continuing Explorer series spacecraft integration, and meeting new Space Station commitments. The existing facilities represent a 20-year-old, obsolete capability, which is fully utilized and not adequate for current program requirements. The first

increment (FY 1987) provides the site preparation and a basic building structure. This final increment is required to provide a complete and useable facility.

PROJECT JUSTIFICATION:

This project will complete the Spacecraft Systems Development and Integration Facility. The FY 1987 increment, which was included in the FY 1987 CoF program, prepares the site and provides a basic building structure. The FY 1988 increment is essential for providing a complete and useable facility and includes the installation of interior equipment, cranes, air-handling equipment, high-efficiency particulate air (HEPA) filters, and electrical systems. This final increment also provides the site with parking areas, access road completion, landscaping, and testing, checkout and certification of design operating conditions for the entire facility.

The Goddard Space Flight Center's (GSFC) impending programmatic needs cannot be met with the existing old, obsolete facility capabilities. The Center's successful experience in the pioneering Solar Maximum repair mission has led to its primary agency role in satellite servicing. Ground support for the Hubble Space Telescope (HST) on-orbit servicing will saturate existing capabilities. The Gamma Ray Observatory and the Upper Atmosphere Research Satellite on-orbit servicing will closely follow the HST requirement and begin in the early 1990s.

GSFC's basic institutional capability for scientific payload integration is currently fully utilized. There are continuing requirements for integration of Explorer and other payloads. The Cosmic Background Explorer is now in progress, and the Extreme Ultraviolet Explorer integration is planned to begin in late 1988. Other, perhaps larger, Explorer payloads are planned for the early 1990s. There are also requirements for smaller payloads such as Spartans, and subsystems of payloads being integrated elsewhere which make extensive short-term use of the GSFC Facilities.

GSFC also will have new responsibilities in supporting Space Station. Space Station interface verification is planned to begin in the 1990-1992 timeframe. Interface verification will encompass work on platforms, attached payloads, and maintenance techniques such as the robotic servicer. Integration of platforms and attached payloads will be undertaken beginning in 1993-1996. Adequate planning for these activities is heavily dependent on an existing or approved facility.

This facility will significantly enhance GSFC's ability to retain and maintain the necessary in-house expertise in research, development, integration, and test activities and keep GSFC viable as an institution at the forefront of space programs.

IMPACT OF DELAY:

Delay of this project would adversely affect GSFC's currently defined responsibilities for satellite servicing; continuation of ongoing Explorer and other payloads integration and the viability of GSFC facilities to support the future (1990s) space flight programs, including the Space Station. In addition, delay in the approval of the second increment of this project will interrupt the construction phasing and result in a partially completed facility. This will necessitate additional and expensive activities to protect materials and system interfaces to ensure integrity and prevent damage during the construction interruption.

PROJECT DESCRIPTION:

The project will provide the second and final increment of construction for the addition of approximately 78,800 gross square feet to the north side of the Building 7/10/15 complex (Figure 2). This increment will install interior building equipment such as cranes and air handling equipment; purchase, install, and test highly sophisticated air filtering systems; provide the finishing and testing of the clean room interiors; furnish the site work such as parking areas, and roads; and complete mechanical and electrical systems.

The facility addition (Figure 3) includes a 12,500-square-foot high-bay laminar flow clean room with 90,000 cubic feet per minute of class 100 filtered air entering the room at the north side through a state-of-the-art floor-to-ceiling, wall-to-wall, high-efficiency particulate air (HEPA) filter bank. This filtering system will produce a cleanliness level of at least class 10,000 within all work stations in a room capable of accommodating the development and integration of two full shuttle bay payloads. Other features of the addition include a 35-ton crane in the staging, shipping and receiving area; a passenger/freight elevator; a dual type electrical power system to provide redundancy; and a fire protection and utility control system which will be connected to the center wide utility control system.

PROJECT COST ESTIMATE:

This cost estimate is based on a final design.

	<u>Unit of Measure</u>	<u>Quantity</u>	<u>Unit cost</u>	<u>cost</u>
<u>Land Aquisition</u>	---	---	---	---
<u>Construction</u>	---	---	---	<u>8,600,000</u>
Site development	LS	---	---	914,000
Bridge cranes.....	LS	---	---	1,709,000
Basic general building construction.....	LS	---	---	2,064,000
Interior construction.....	LS	---	---	258,000
Mechanical.....	LS	---	---	2,634,000
Electrical.....	LS	---	---	1,021,000
<u>Equipment</u>	---	---	---	<u>---</u>
<u>Fallout Shelter</u> (not feasible)	---	---	---	<u>---</u>
Total.....				<u><u>8,600,000</u></u>

NOTE: This cost estimate provides the FY 1988 second and final increment to the facility. The total estimated cost of the project, including the FY 1987 increment of \$8 million, is \$16.6 million.

LIST OF RELATED GRAPHICS:

Figure 1 - Location Plan
Figure 2 - Floor Plan
Figure 3 - Isometric Section

OTHER EQUIPMENT SUMMARY:

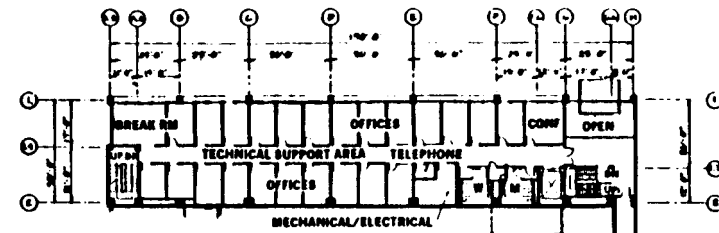
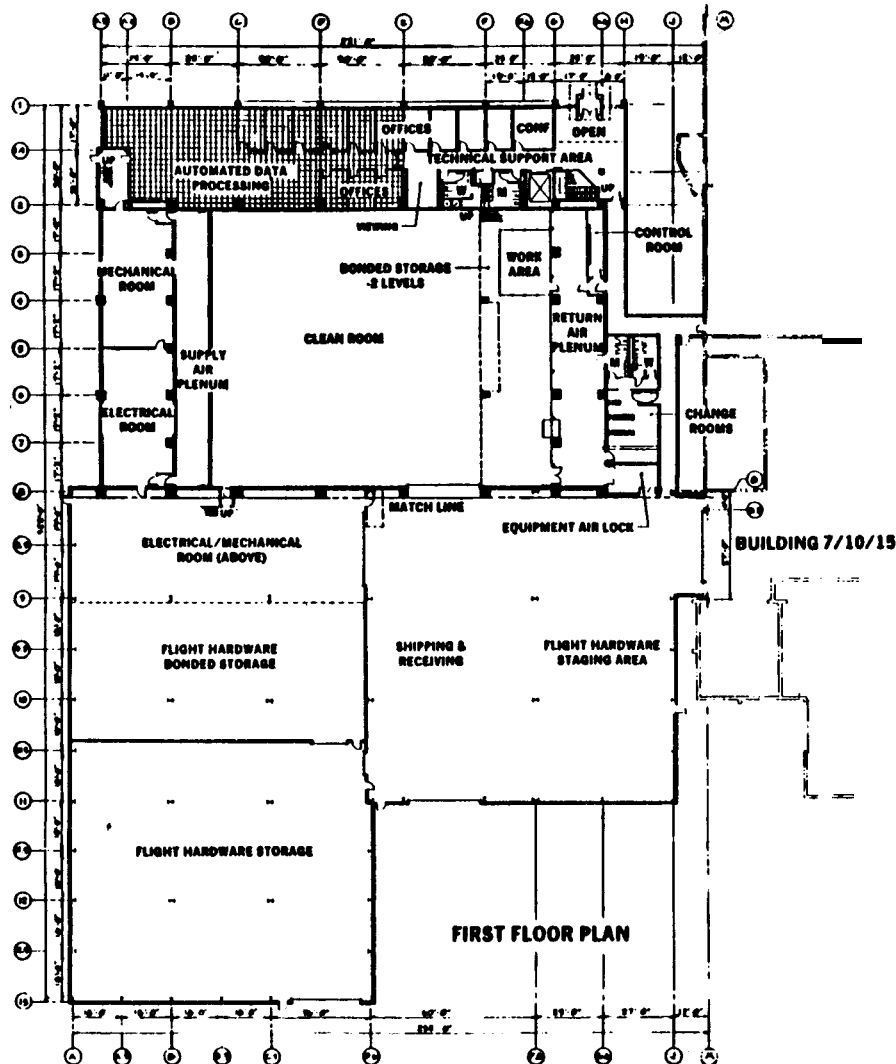
Materials handling equipment estimated to cost \$50,000 will be provided from R&PM resources.

FUTURE CoF ESTIMATED FUNDING REQUIRED TO COMPLETE THIS PROJECT:

No future funding is required to complete this project.

GODDARD SPACE FLIGHT CENTER
FISCAL YEAR 1988 ESTIMATES
CONSTRUCTION OF SPACECRAFT SYSTEMS DEVELOPMENT AND INTEGRATION FACILITY

FLOOR PLAN



SECOND FLOOR PLAN

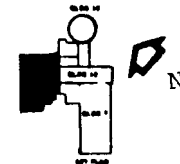


FIGURE 2

GODDARD SPACE FLIGHT CENTER
FISCAL YEAR 1988 ESTIMATES
CONSTRUCTION OF SPACECRAFT SYSTEMS DEVELOPMENT AND INTEGRATION FACILITY
ISOMETRIC SECTION

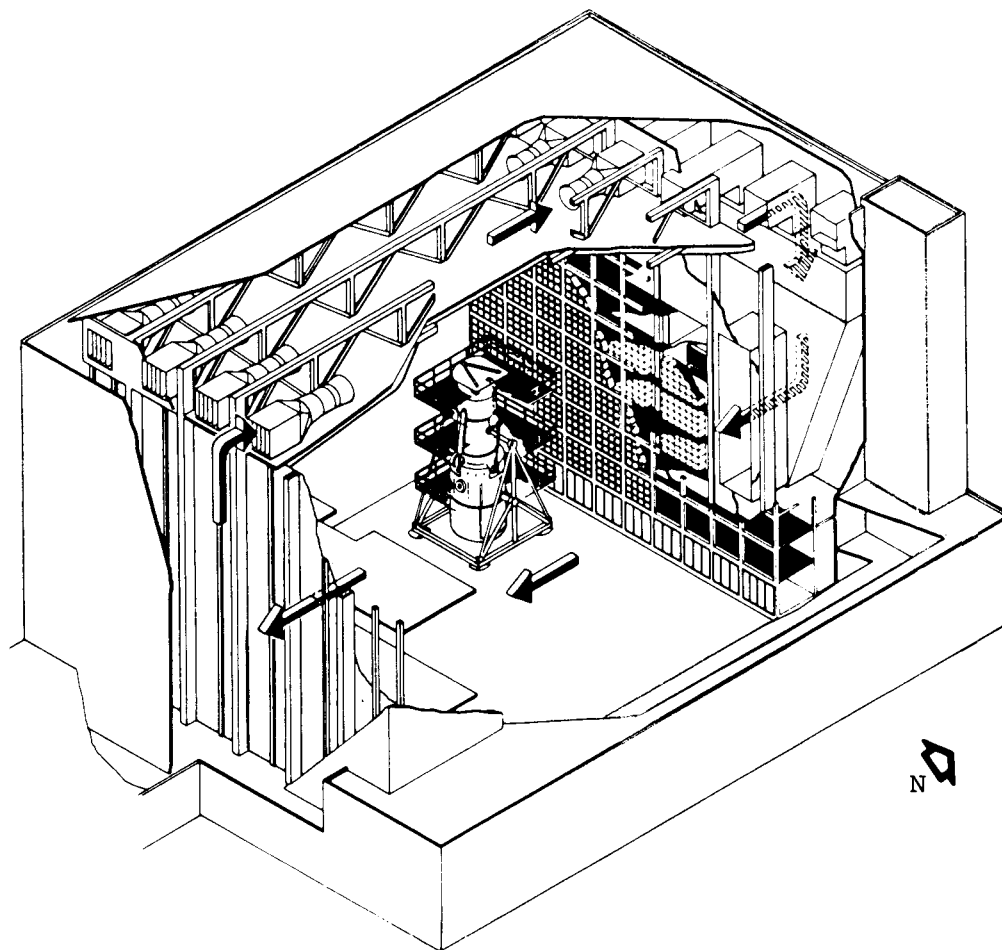


FIGURE 3

GODDARD SPACE FLIGHT CENTER
FISCAL YEAR 1988 ESTIMATES
MODIFICATIONS FOR UTILITY RELIABILITY

LOCATION PLAN

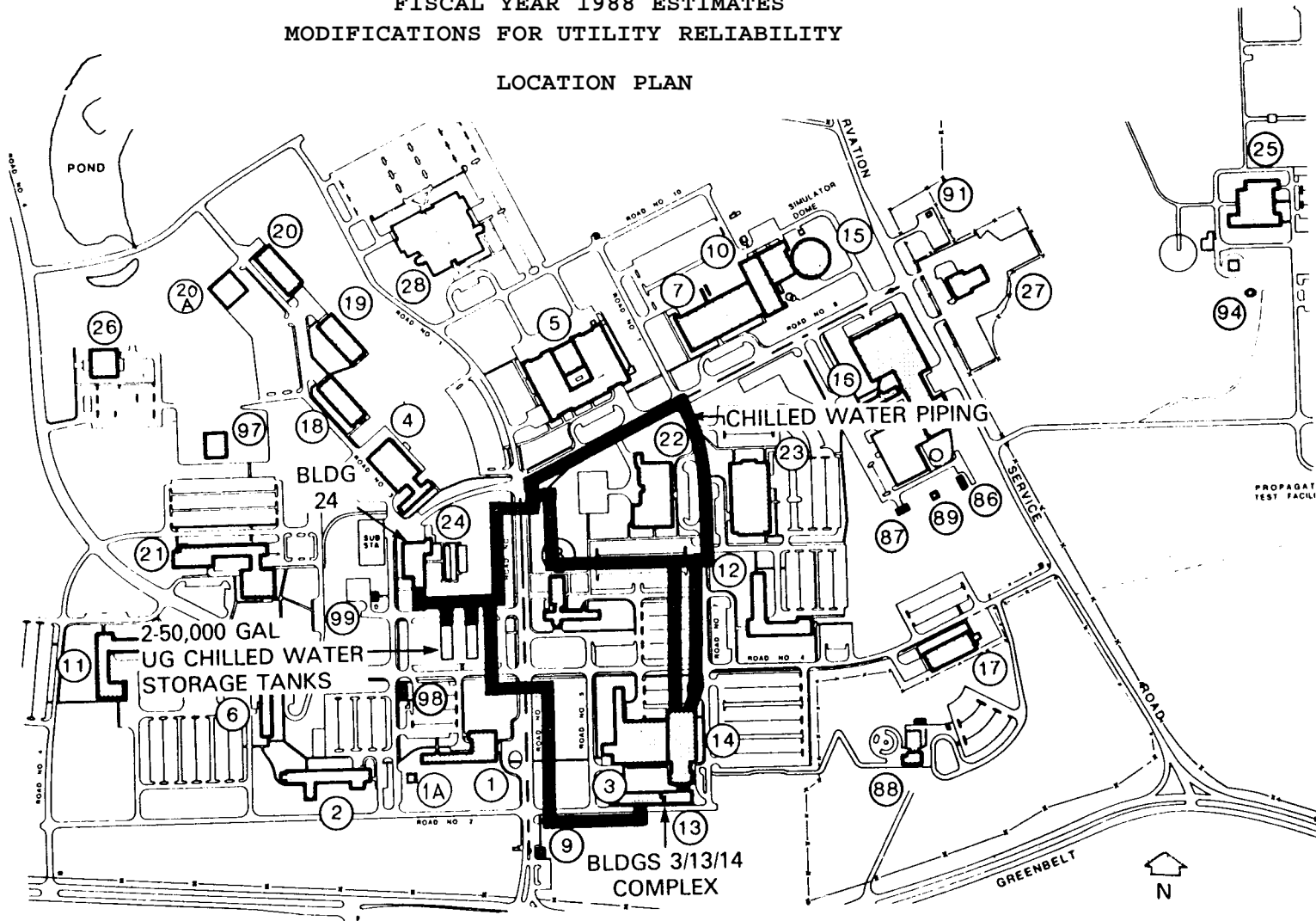


FIGURE 1

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1988 ESTIMATES

PROJECT TITLE:	<u>Modifications for Utility Reliability</u>
INSTALLATION:	<u>Goddard Space Flight Center</u>
FY 1988 CoF Estimates: <u>\$2,900,000</u>	

LOCATION OF PROJECT: Greenbelt, Prince George's County, Maryland

COGNIZANT HEADQUARTERS OFFICE: Office of Space Science and Applications

FY 1987 AND PRIOR YEARS' FUNDING: The following prior years' funding is related to this project:

	<u>Planning and Design</u>	<u>Construction</u>	<u>Total</u>
Specific CoF funding.	\$150,000	---	\$150,000
Capitalized investment.....	---	---	---
Total.....	<u>\$150,000</u>	<u>---</u>	<u>\$150,000</u>

SUMMARY PURPOSE AND SCOPE:

This project provides for increased reliability of the Goddard Space Flight Center (GSFC) chilled water and electrical distribution systems which support communications and control of the Tracking and Data Relay Satellite System, Shuttle flights, major space science and applications satellites and DOD missions. The present system provides emergency backup electrical power for critical data acquisition and communications equipment but no backup for cooling of the same equipment. The result is that a short-term electrical failure shuts down the electronic equipment because of overheating even though electrical power is still available. This project will provide short-term backup for the cooling systems to allow the safeing of satellites and the orderly shutdown of control and communication equipment.

PROJECT JUSTIFICATION:

A major mission of the GSFC is to provide tracking, data acquisition, and control of Earth orbiting spacecraft, and warehousing, and distribution of technical data. With the advent of manned spacecraft the control and communication functions increased extensively. For the Mercury, Gemini, and Apollo Missions, all data on the condition of the men and machines had to be analyzed in real time and the data flow from the applications spacecraft (communications, weather, etc.) further increased the demand for real-time receiving and processing. In the TDRSS and Space Shuttle era, the demands on the system have again taken a significant increase causing the GSFC communications and control complex to operate 24 hours a day. This operation has become extremely critical to TDRSS support of major satellite, Shuttle flights, and certain DOD payloads.

In order to keep pace with the rise in demand for services, new computers and communications equipment have been added or have replaced older models. Facilities to support this equipment have also been constructed. This includes chillers for increased chilled water distribution necessary to cool the electronic equipment. Secondary (or backup) utility systems especially for cooling were not included. No additional backup diesel generators have been added since 1965. The result is that backup power capability to fully operate the existing cooling system during electrical power shortages is not adequate. While commercial power is normally reliable, the present air-conditioning system is essentially disabled by short power interruption. While critical electronic equipment is supported by uninterruptable power supplies (UPS) for 15 minutes, without cooling, computer spaces overheat and require operating equipment to be shut down within 5 minutes after the electric power fails. It is essentially impossible to put all electronic and computer equipment and spacecraft into a "safe" mode within these 5 minutes and this causes abrupt cessation of satellite control and data handling. By providing uninterrupted air-conditioning support for at least 15 minutes, this project will provide adequate protection against the short-term failures which are the most likely to occur.

IMPACT OF DELAY:

With the advent of the TDRSS and the probability of multiple STS flights each year, the critical areas of GSFC will be in mission status on a continuous basis. Delay of this project will extend the risk that a minor power failure will disable the Center's chilled water system and cause an abrupt shutdown of mission support control and communications.

PROJECT DESCRIPTION:

Small emergency power plants will be provided to operate chilled water pumps, critical air handlers, booster pumps and controls. A 500KW diesel, now excess to the Ground Tracking System will be located near Building 24 and a battery backup system will be located at the 3/13/14 complex to provide electrical power for operation of the chilled water system for at least 15 minutes. Automatic valves also will be installed in the chilled

water distribution system for isolation of critical areas. Controls for this system will be located in the power house. A 100,000-gallon chilled water reservoir will be constructed to provide 15-minute (minimum) cooling.

PROJECT COST ESTIMATE:

This project cost estimate is based on a preliminary engineering report.

	<u>Unit of Measure</u>	<u>Quantity</u>	<u>Unit cost</u>	<u>Cost</u>
<u>Land Acquisition</u>	---	---	---	---
<u>Construction</u>	---	---	---	<u>2,900,000</u>
Emergency power system.	LS	---	---	1,890,000
Site work.....	LS	---	---	62,000
Building 24 modifications.....	LS	---	---	343,000
Architectural/structural.....	LS	---	---	(182,000)
Mechanical.....	LS	---	---	(82,000)
Electrical.....	LS	---	---	(79,000)
Chilled water storage system.	LS	---	---	605,000
<u>Equipment</u>	---	---	---	---
<u>Fallout Shelter</u> (not required)	---	---	---	---
<u>Total</u>				<u>2,900,000</u>

LIST OF RELATED GRAPHICS:

Figure 1 - Location Plan
Figure 2 - Chilled Water Storage

OTHER EQUIPMENT SUMMARY:

Equipment will be relocated, but no new equipment is anti

FUTURE CoF IMATED FUNDING REQUESTED TO LETE S PROJECT:

No : CoF fundi is : complete this project.

GODDARD SPACE FLIGHT CENTER
FISCAL YEAR 1988 ESTIMATES
MODIFICATIONS FOR UTILITY RELIABILITY

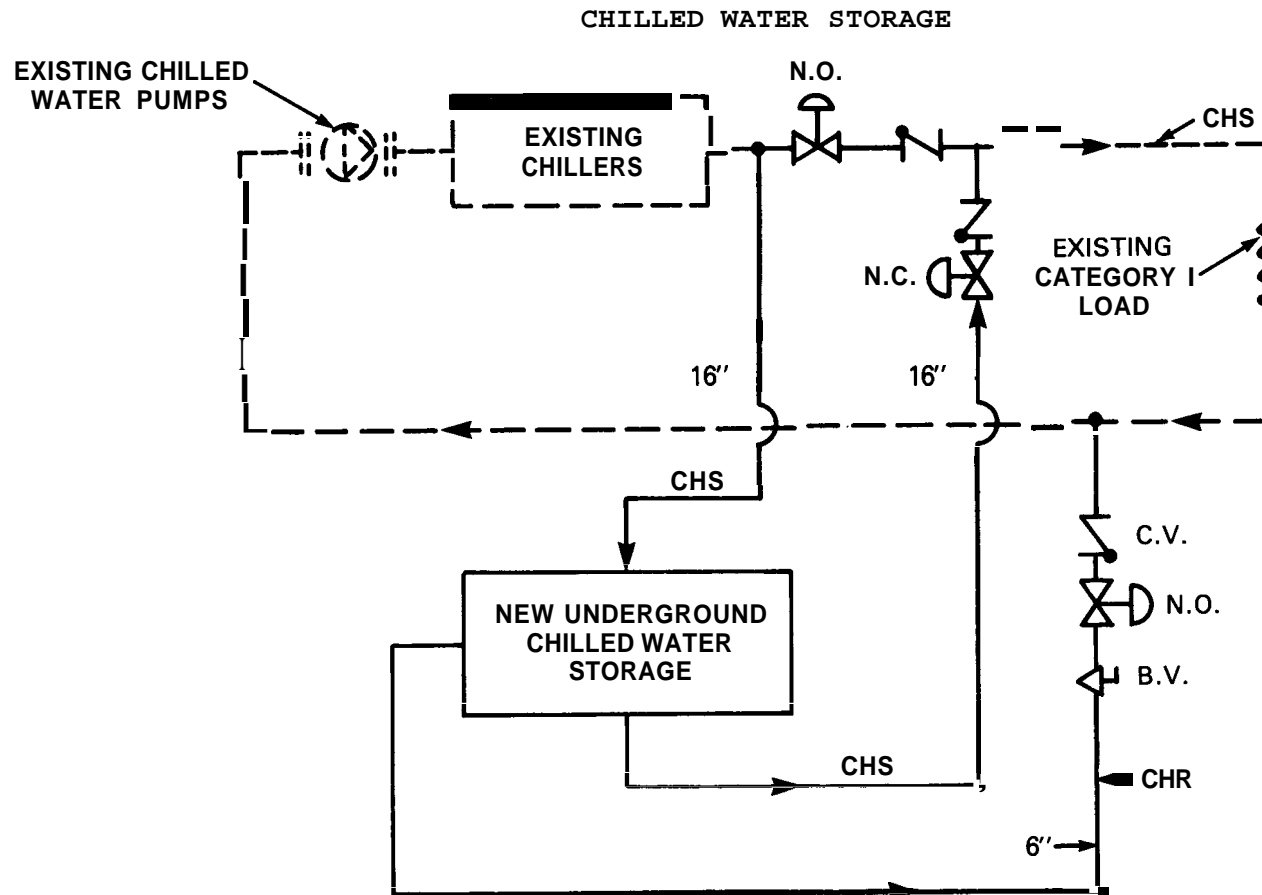


FIGURE 2

DRYDEN
FLIGHT RESEARCH
CENTER



NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1988 ESTIMATES

SUMMARY

DRYDEN FLIGHT RESEARCH FACILITY

<u>Office of Aeronautics and Space Technology:</u>	<u>Amount</u>	<u>Page No.</u>
Construction of Integrated Test Facility.	10,500,000	CF 4-1

DRYDEN FLIGHT RESEARCH FACILITY
FISCAL YEAR 1988 ESTIMATES
CONSTRUCTION OF INTEGRATED TEST FACILITY

LOCATION PLAN

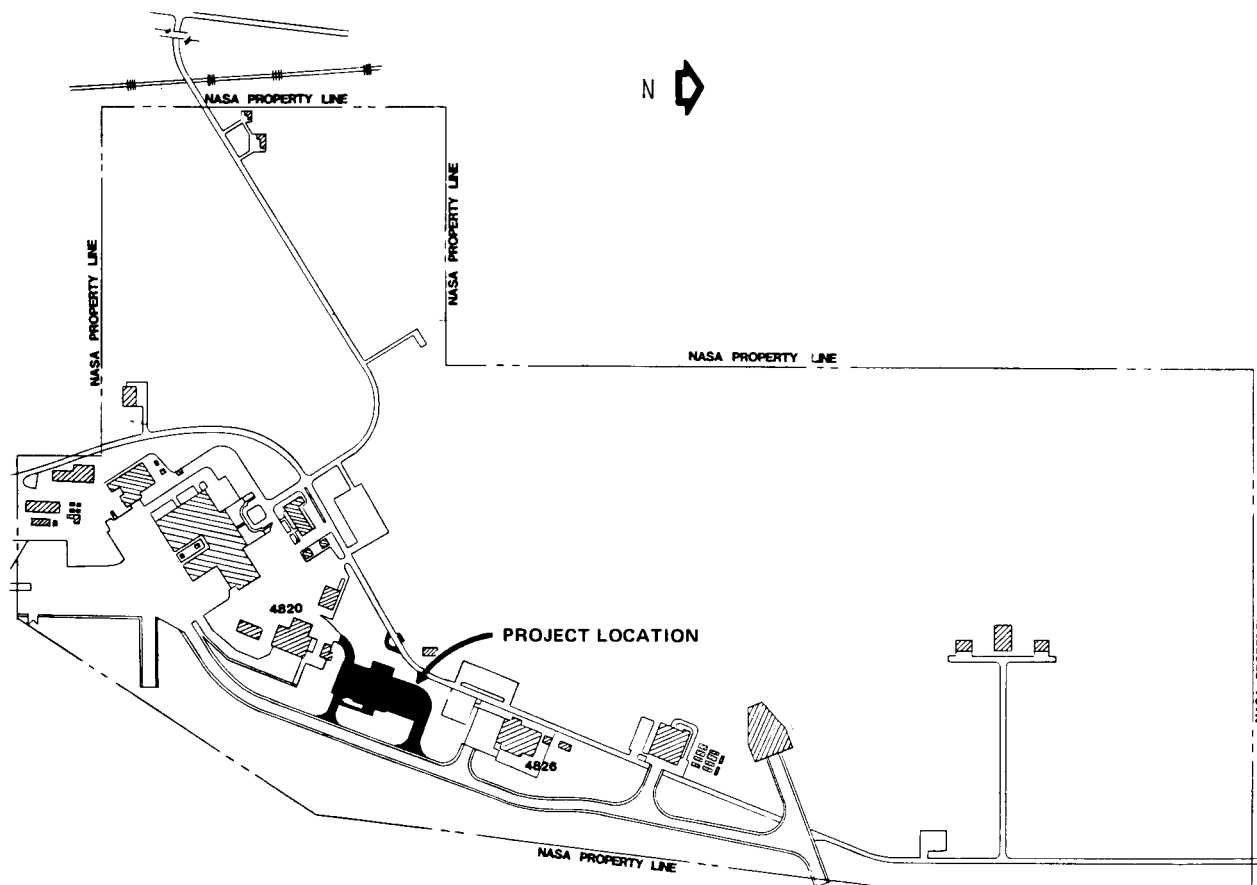


FIGURE 1

CONSTRUCTION OF FACILITIES

FISCAL YEAR '1988 ESTIMATES

PROJECT TITLE:	<u>Construction of Integrated Test Facility</u>
INSTALLATION:	<u>Dryden Flight Research Facility</u>
	FY 1988 CoF Estimate: <u>\$10,500,000</u>

LOCATION OF PROJECT: Edwards AFB, Kern County, California

COGNIZANT HEADQUARTERS OFFICE: Office of Aeronautics and Space Technology

FY 1987 AND PRIOR YEARS' FUNDING: The following prior years' funding is related to this project:

	<u>Planning and Design</u>	<u>Construction</u>	<u>Total</u>
Specific CoF funding.. ..	1,200,000	7,500,000	8,700,000
Capitalized investment.....	N/A	---	---
Total.....	<u>1,200,000</u>	<u>7,500,000</u>	<u>8,700,000</u>

SUMMARY PURPOSE AND SCOPE:

This project will complete the construction of the Integrated Test Facility (ITF) to provide an adequate ground testing facility to help NASA maintain its pre-eminence in aeronautical research. The facility will provide aircraft test areas and computer laboratory space to test complex and highly interactive/integrated systems of both present and future aircraft. This increment provides the exterior cladding, mechanical and electrical systems, and interior architectural finishes.

PROJECT JUSTIFICATION:

NASA requires an Integrated Test Facility (ITF) for developmental testing of systems driven aircraft (i.e., aircraft dominated by digital flight control systems) prior to and during the flight test program. Based on the number of programs involving these types of aircraft, the increased degree of interaction between systems, and the dominance of the systems over aircraft flight behavior, it will be highly inefficient at best to continue to support these flight programs with the current facilities which are separated in approximately eight different locations and are not suitable for support of total systems integration testing.

Existing facilities are only able to support a limited number of system driven aircraft. This has the effect of forcing each new program to purchase specialized test equipment to meet the needs of new requirements. Another deficiency is marginal or no signal communications links between aircraft, simulation laboratories, and the remote testing areas. No capability exists for operating an engine while exercising the flight control loops through the aerodynamic simulations. This is critical for aircraft with integrated flight propulsion control systems. No capability now exists to check out special sensor devices such as laser gyros and infrared sensors. There is no Electromagnetic Interference (EMI) shielding from background radiation during calibration tests, nor to prevent unauthorized satellite capture of secure radiation patterns. Also, ground vibration, moment of inertia, and aeroservoelastic ground testing are limited by a lack of environmentally controlled test areas and hangar space with adequate height and strength to support dynamic testing of structural components, as well as the entire aircraft.

The construction provided by this project will complete the deferred portion of the originally authorized FY 1987 increment. Deferring part of the project into the FY 1988 program was considered prudent based on construction schedules, long lead deliveries, and budget constraints. The FY 1987 increment provided for site preparation, utilities, and the building's structural steel framing. This increment will complete the facility.

IMPACT OF DELAY:

NASA currently has no facility capable for integrated system testing. Existing facilities can provide complex tests on simple systems, but not complex tests on complex systems. Without an integrated testing capability, more risks will be incurred in flight; a "mini - ITF" must be developed for each specific program at higher costs; all tests must be conducted in piecemeal fashion; development and qualification time will be extended; and higher risk flight testing will be required to qualify systems. Without this phase of funding the facility will not be usable for activation of planned test programs.

PROJECT DESCRIPTION:

This project provides for construction of a 112,000-square foot Integrated Test Facility composed of six (6) aircraft hangar-type test bays totaling 53,000 square feet and an adjoining 59,000-square foot two-story masonry structure housing computer, laboratory, office, and technical support areas. Each of the six test bays will be large enough to house conventional and/or experimental type fighter or research aircraft, or three bays can be opened to accommodate large aircraft. Each test bay will be provided with data bus and discrete interface control and logic points, power (115VAC, 208VAC, 28VDC, 270VDC at 400 Hz and 60Hz), cooling air for aircraft systems, hydraulic support systems, ambient heating systems, industrial waste collection systems, fire suppression, shop air, overhead cranes, and shielding. At least one bay will be provided with EMI shielding to protect sensitive electronic systems from externally generated electromagnetic radiation. The laboratories and shop areas will be provided with power, HVAC, plumbing, fire detection and suppression, a central 4,000 psig hydraulic system manifolded throughout the complex, compressed air, lighting, and emergency power. Also to be provided is a building grounding system including separate aircraft test system grounds, lightning protection, and landscaping. The site preparation, utilities, and the building's structural steel framing was provided by the FY 1987 increment.

PROJECT COST ESTIMATE:

The current cost estimate is based on a June 1985 Preliminary Engineering Report.

	<u>Unit of Measure</u>	<u>Quantity</u>	<u>Unit cost</u>	<u>cost</u>
<u>Land Acquisition..</u>	---	---	---	---
<u>Construction.....</u>	---	---	---	10,500,000
Architectural/structural.....	SF	112,000	44.65	4,800,000
Mechanical.....	SF	112,000	35.72	3,800,000
Electrical.....	SF	112,000	17.86	1,900,000
<u>Equipment..</u>	---	---	---	---
<u>Fallout Shelter (not feasible).....</u>	---	---	---	---
Total.....				10,500,000

Note: This cost estimate provides the FY 1988 increment to the facility. The total estimated cost of the project is \$18,000,000.

LIST OF RELATED GRAPHICS:

Figure 1 - Location Plan
Figure 2 - Interior View

OTHER EQUIPMENT SUMMARY:

Computer equipment and aircraft test equipment is presently at Dryden and will be supplemented with equipment purchased with \$2,900,000 of FY 1988 and 1989 R&D funds.

FUTURE CoF ESTIMATED FUNDING REQUIRED TO COMPLETE THIS PROJECT:

No additional CoF funding is anticipated to complete this project.

DRYDEN FLIGHT RESEARCH FACILITY
FISCAL YEAR 1988 ESTIMATES
CONSTRUCTION OF INTEGRATED TEST FACILITY

INTERIOR VIEW

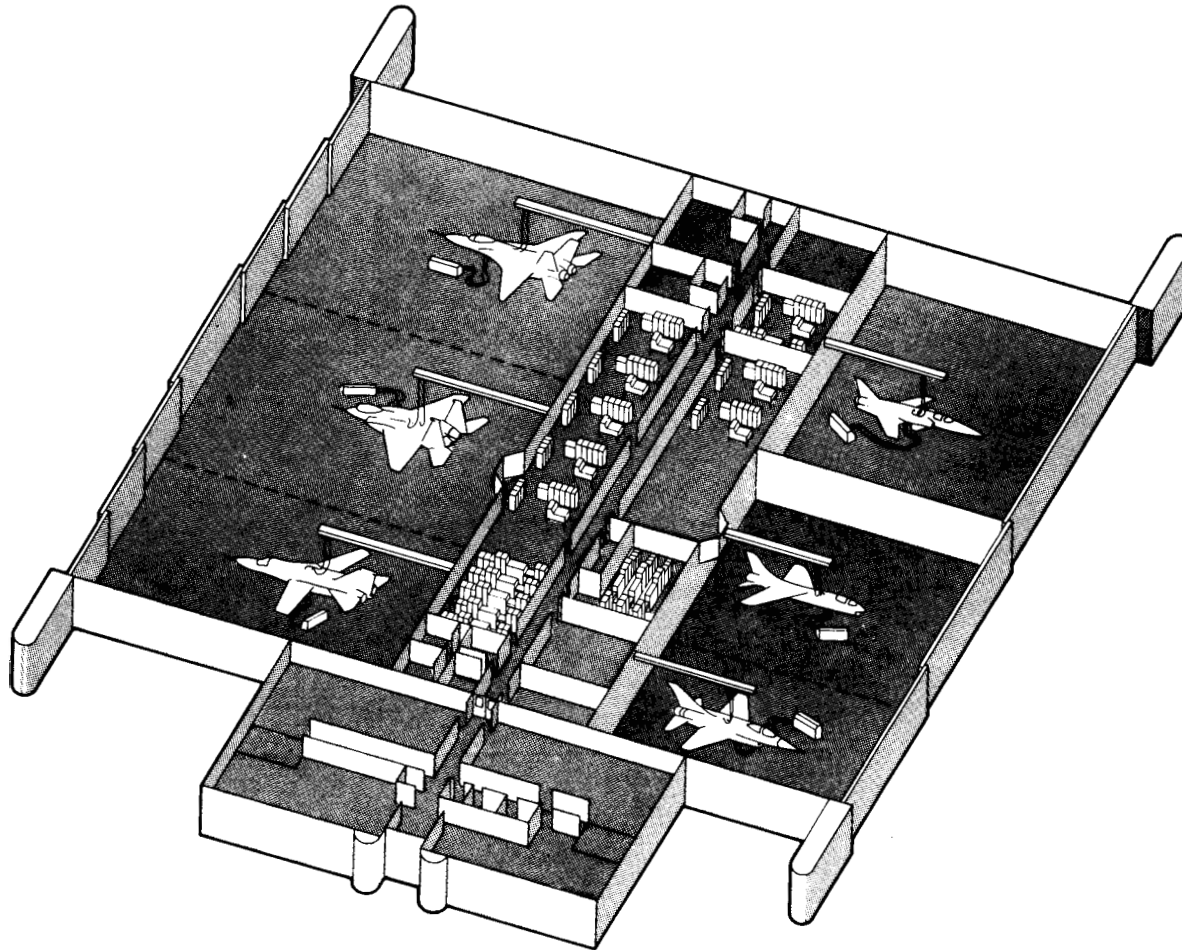


FIGURE 2

CF 4-6

LANGLEY
RESEARCH CENTER

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1988 ESTIMATES

SUMMARY

LANGLEY RESEARCH CENTER

Office of Aeronautics and Space Technology:

Amount

Page No.

Modifications to Hypersonic Propulsion Facility for Vacuum Systems..... 3,100,000

CF 5-1

LANGLEY RESEARCH CENTER
FISCAL YEAR 1988 ESTIMATES
MODIFICATIONS TO HYPERSONIC PROPULSION FACILITY FOR VACUUM SYSTEMS
LOCATION PLAN

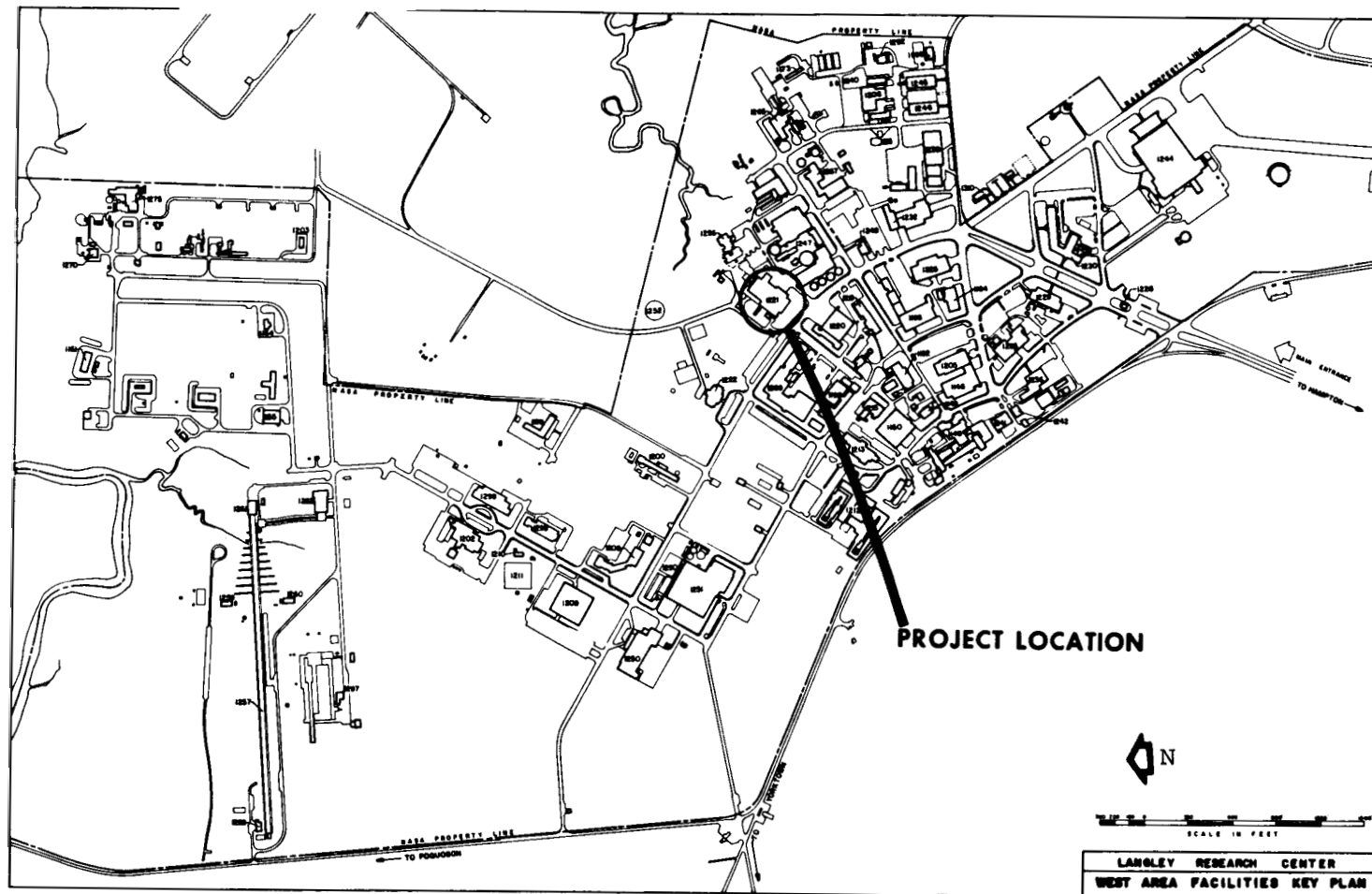


FIGURE 1

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1988 ESTIMATES

PROJECT TITLE:	<u>Modifications to Hypersonic Propulsion Facility to Add New Vacuum System</u>
INSTALLATION:	<u>Langley Research Center</u>
	FY 1988 CoF Estimate: <u>\$3,100,000</u>

LOCATION OF PROJECT: Hampton, Virginia

COGNIZANT HEADQUARTERS OFFICE: Office of Aeronautics and Space Technology

FY 1987 AND PRIOR YEARS' FUNDING: The following prior years' funding is related to this project:

	<u>Planning and Design</u>	<u>Construction</u>	<u>Total</u>
Specific CoF funding.. .. .	\$325,658	\$ -0-	\$ 325,658
Capitalized investment.....	<u>N/A</u>	<u>7,478,376</u>	<u>7,478,376</u>
Total.....	<u>\$325,658</u>	<u>\$7,478,376</u>	<u>\$7,804,034</u>

SUMMARY PURPOSE AND SCOPE:

This project will modify the existing hypersonic propulsion facilities to provide scramjet research capability by installing a new vacuum system. Included are: installation of a 70-foot vacuum sphere; replacement of the air ejector with a new four-stage steam ejector system with condensers, muffler, lines, and controls to pump the sphere; lines and controls to provide steam for the ejector; vacuum lines from the test cells to the sphere; and associated isolation valves and cooling system.

PROJECT JUSTIFICATION:

Hypersonic Propulsion Test Cells 1 and 2, and the Scramjet Test Facility at the Langley Research Center are the only facilities in NASA for small-scale, high-run-frequency scramjet (supersonic combustion ramjet) combustor and inlet-combustor component integration engine testing. Together they provide a general purpose capability for supporting research in scramjet combustor design, fuel injector configurations, ignition, flameholding, hypersonic inlet performance, and complete subscale engine performance.

The Langley facilities represent a substantial national asset for the extension of scramjet technology. NASA Langley has the only broad-based, comprehensive technology program in the country related to sustained hypersonic flight in the atmosphere. These facilities have been utilized extensively over the last several years in research related to highly airframe-integrated, hydrogen-fueled engine concepts. In addition, the U.S. Navy has conducted studies over several years that show the scramjet to be the preferred propulsion option for several defense requirements.

The two test cells provide an ideal environment for testing with liquid hydrogen and hydrocarbon fuels. The walls and structure are designed for one atmosphere differential pressure and were originally designed for turbojet use. Their present primary limitation is the exhaust system. Although air ejectors provide a limited back pressure/altitude simulation, facility-model interactions can occur in Test Cell 1 even at the nominal Mach 4 test condition. Also, Mach 5 testing is constrained to 70,000 feet whereas 95,000 feet is desired, and no meaningful Mach 6 test point can be achieved. Extending the capacity of the present air ejectors is not feasible because air flow rates are now very close to the maximum available. The new 70-foot vacuum sphere will provide the needed reduced back pressure capability, allowing Mach 4 to 6 testing in Cell 1, with altitude simulation from 50,000 to 100,000 feet and run times in excess of 1 minute (or for 25 seconds at the highest flow expected). In addition, the vacuum sphere would effectively uncouple the test cells from the group of facilities which compete for air service and raise their productivity.

IMPACT OF DELAY:

Delay of this project will impact the NASA hypersonic propulsion research program by severely restricting test capability. At a time when the national hypersonic program is rapidly expanding and when critical hypersonic propulsion research is needed for DARPA, USAF, Navy and NASA programs, the necessary basic scramjet propulsion research data would not be available when needed.

PROJECT DESCRIPTION:

This project provides for the following: (1) a 70-foot vacuum sphere; (2) approximately 200 feet of 4-foot vacuum lines, three remote-operation isolation valves, cooling system, and blowout diaphragm; and (3) a four-stage steam ejector and lines and controls to provide steam for the ejector (approximately 26,000 pounds per hour of steam).

The sphere will be located adjacent to the rear of the Building 1221 in an area previously occupied by air dryers. Piping from the test cells to the sphere will be run from the downstream end of the test cells, out the roof (similar to current exhaust system), and across to the sphere.

PROJECT COST ESTIMATE:

Project cost estimates are based on a preliminary engineering report.

	<u>Unit of Measure</u>	<u>Quantity</u>	<u>Unit cost</u>	<u>cost</u>
<u>Land Acquisition</u>	---	---	---	---
<u>Construction</u>	---	---	---	<u>\$3,100,000</u>
Vacuum system	EA	---	---	655,000
Cooling water system.	LS	---	---	165,000
Steam system....	LS	---	---	90,000
Sphere.	LS	---	---	1,885,000
Sphere foundations.....	LS	---	---	40,000
Pumphouse, ejector supports.	LS	---	---	215,000
Power supply....	LS	---	---	30,000
Controls.....	LS	---	---	20,000
<u>Equipment</u>	---	---	---	<u>---</u>
<u>Fallout Shelter (not feasible).</u>	---	---	---	<u>---</u>
Total.....				<u><u>3,100,000</u></u>

LIST OF RELATED GRAPHICS:

Figure 1 - Location Plan

Figure 2 - Site Plan

Figure 3 - Test Facility Simulation of Ramjet-Scramjet Flight

Figure 4 - Site Plan and Schematic of Proposed Sphere

OTHER EQUIPMENT SUMMARY:

No additional equipment is required.

FUTURE CoF ESTIMATED FUNDING REQUIRED TO COMPLETE THIS PROJECT:

At this time there are no requirements for future CoF funding for this project.

LANGLEY RESEARCH CENTER
FISCAL YEAR 1988 ESTIMATES
MODIFICATIONS TO HYPERSONIC PROPULSION FACILITY FOR VACUUM SYSTEMS

SITE PLAN

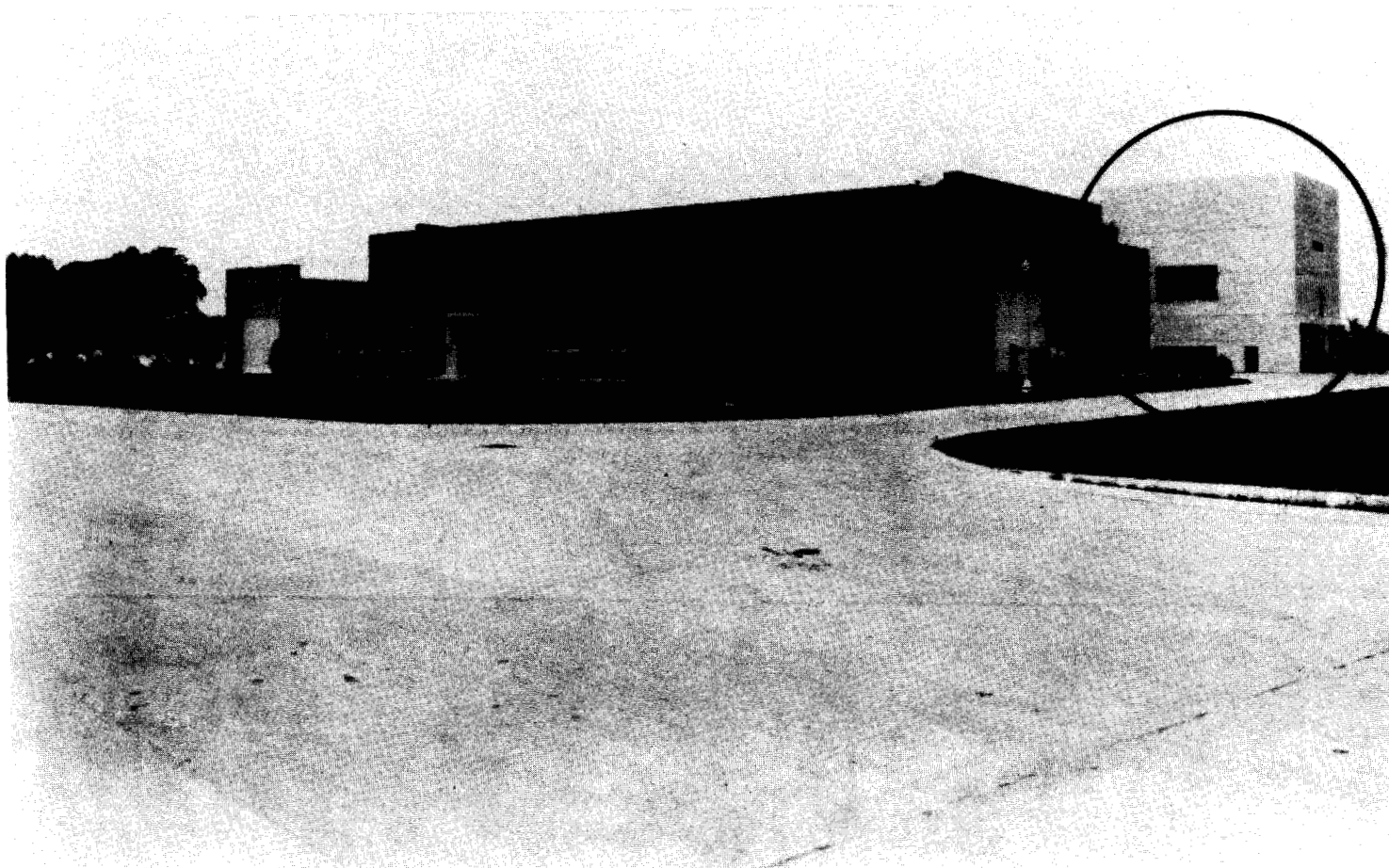


FIGURE 2

LANGLEY RESEARCH CENTER
 FISCAL YEAR 1988 ESTIMATES
 MODIFICATIONS TO HYPERSONIC PROPULSION FACILITY FOR VACUUM SYSTEMS
 TEST FACILITY SIMULATION OF RAMJET-SCRAMJET FLIGHT

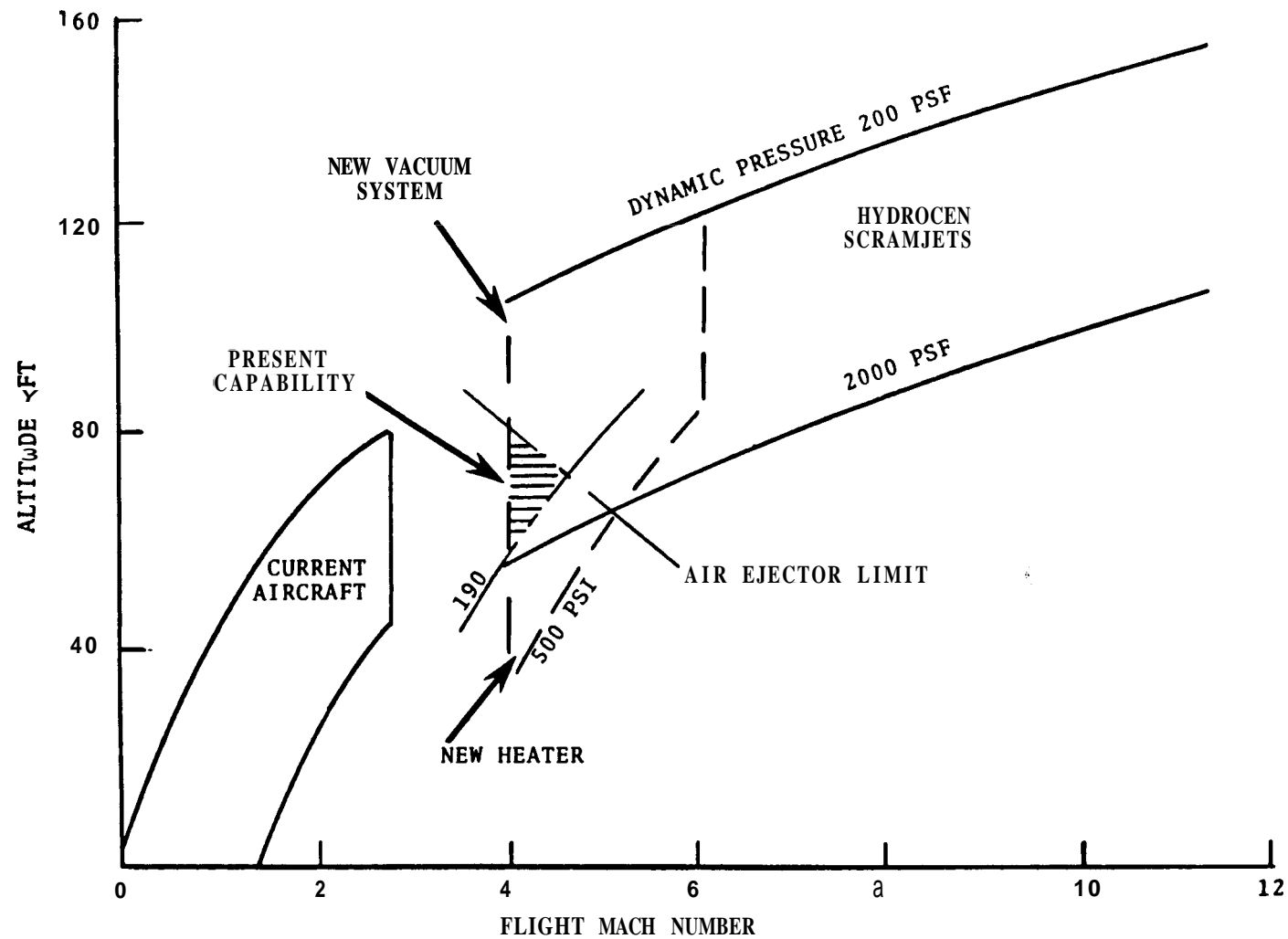


FIGURE 3

LANGLEY RESEARCH CENTER
FISCAL YEAR 1988 ESTIMATES
MODIFICATIONS TO HYPERSONIC PROPULSION FACILITY FOR VACUUM SYSTEMS

SITE PLAN AND SCHEMATIC OF PROPULSION FACILITY

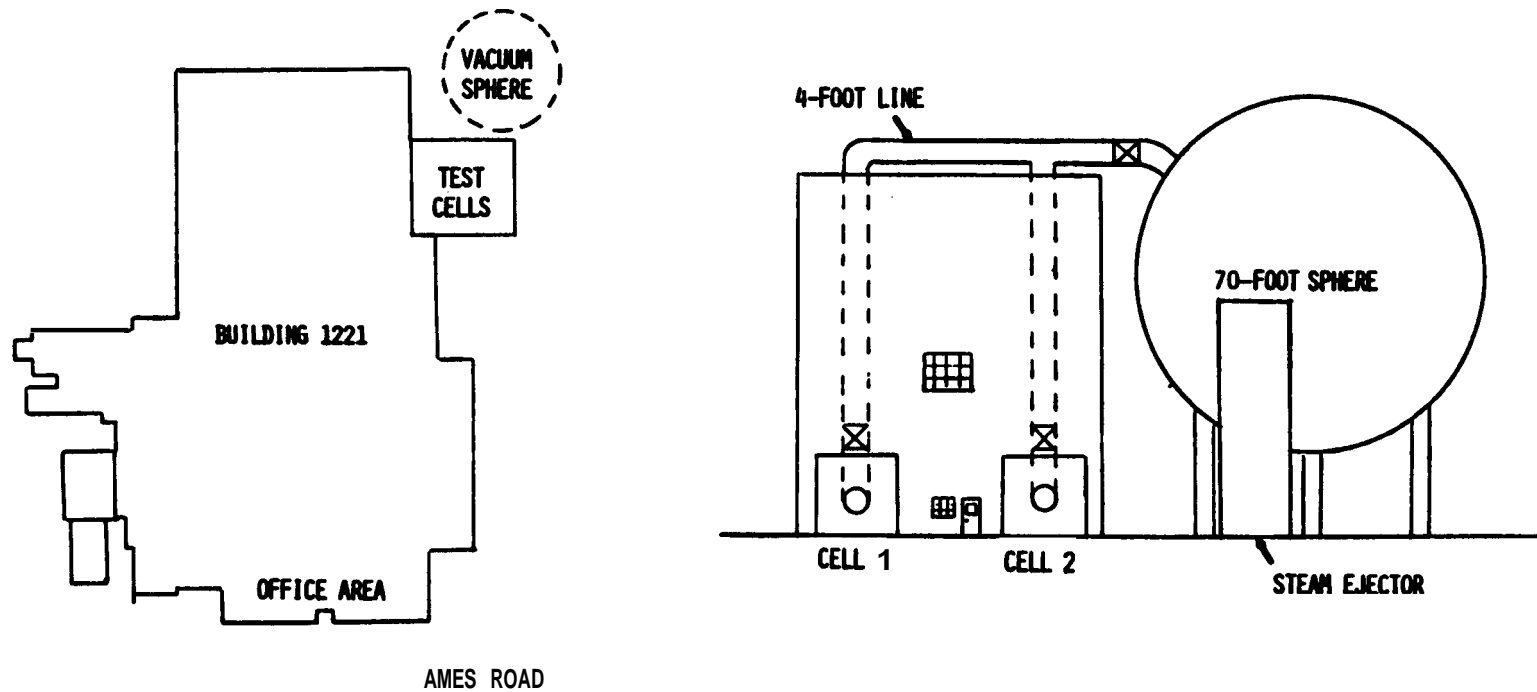


FIGURE 4

LEWIS
RESEACRH CENTER

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1988 ESTIMATES

SUMMARY

LEWIS RESEARCH CENTER

<u>Office of Aeronautics and Space Technology:</u>	<u>Amount</u>	<u>Page No.</u>
Construction of Addition to the Research Analysis Center	9,800,000	CF 6-1
Modifications for Fan/Compressor Research, Engine Research Building	<u>6,500,000</u>	CF 6-9
Total	<u>16,300,000</u>	

LEWIS RESEARCH CENTER
FISCAL YEAR 1988 ESTIMATES
CONSTRUCTION OF ADDITION TO THE RESEARCH ANALYSIS CENTER
LOCATION PLAN

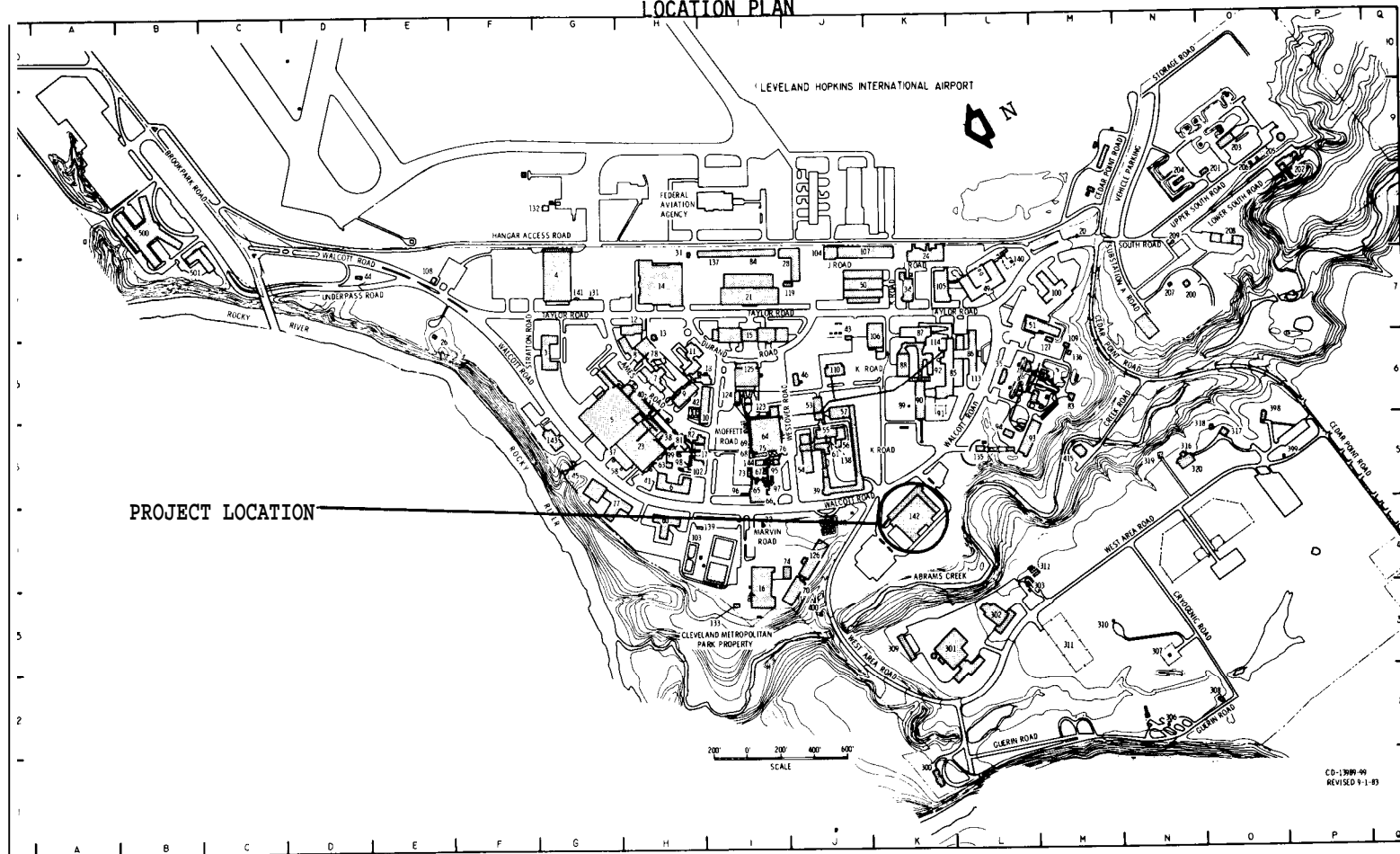


FIGURE 1

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1988 ESTIMATES

PROJECT TITLE:	Construction of Addition to the Research Analysis Center
INSTALLATION:	Lewis Research Center (LeRC)
FY 1988 CoF Estimate: \$9,800,000	

LOCATION OF PROJECT: Cleveland, Cuyahoga County, Ohio

COGNIZANT HEADQUARTERS OFFICE: Office of Aeronautics and Space Technology (OAST)

FY 1987 AND PRIOR YEARS' FUNDING: The following prior years' funding is related to this project:

	<u>Planning and Design</u>	<u>Construction</u>	<u>Total</u>
Specific CoF funding.	\$779,000	\$ ---	\$ 779,000
Capitalized investment.....	---	6,426,000	6,426,000
Total.....	<u>\$779,000</u>	<u>\$6,426,000</u>	<u>\$7,205,000</u>

SUMMARY PURPOSE AND SCOPE:

This project will provide an addition to the Research Analysis Center (RAC) of approximately 46,000 square feet to accommodate the additional ADP equipment along with the support services and personnel required to satisfy accelerated computational requirements at LeRC. The demand for additional equipment and services has greatly increased since the RAC was completed in 1980 because of the theoretical, scientific, and engineering changes at LeRC which required increased computational support. The addition includes 11,000 square feet of computer operations area incorporating safety, mechanical, electrical, and environmental systems, 16,400 square feet of computer support area, 9,100 square feet of office area, and 9,500 square feet of utility area.

PROJECT JUSTIFICATION:

Since the RAC Building was completed in 1980, theoretical, scientific, and engineering computer requirements have changed dramatically which have imposed greater demands in areas such as scientific modeling and analysis, finite element analysis, interactive graphics, and CAD/CAM. In addition, the support provided to the business and administrative areas has also increased due to the growth in office automation. The data acquisition and computational support activities for the research test facilities also have almost doubled the space requirements for those functions. In addition to the increased computational requirements, additional requirements have been imposed for specialized systems such as NASA Equipment Management Systems (NEMS), and communications systems such as Time Division Multiple Access (TDMA) of the NASA Communications (NASCOM) Domestic Satellite (DOMSAT) and the Program Support Communications Network (PSCN).

The increased workload has resulted in accelerating the augmentation of the IBM 370/3033AP system which was to be implemented over a period of 6 years, but instead had to be accomplished in less than 3 years in order to keep up with demands.

In addition, the recent acquisitions of both the Cray IS/2200 and the two Amadhl 5840 computer systems were also a result of increased workloads. These computer systems, as well as other systems, require upgrading and augmentation in order to satisfy the near-term project demand for computational requirements. Since the existing computer space in the RAC facility is already saturated, the additional space to be provided by this project to accommodate the planned upgrading and augmentation of the various computer systems is essential.

The original RAC was designed to accommodate 182 people of which 140 required office space. The total personnel complement is now 240 people, including 144 Civil Servants. The support service personnel complement is expected to increase to 147 by FY 1987 and to 186 by FY 1991. Because the support service personnel must be close to the equipment to be effective, it is imperative that their work areas and required support equipment areas be in close proximity to the operations area. This project will provide the needed space for the additional support personnel.

IMPACT OF DELAY:

The space required to house the added computational and support systems has greatly exceeded existing capability of the RAC facility. In order to alleviate the space requirements, systems areas have been compressed when possible at the expense of both operations and maintenance efficiency and effectiveness.

The ability of LeRC to provide computational capability adequate to satisfy user needs is essential to the successful attainment of the center's basic operational missions. Projected new programs, additional ADP equipment/staffing, and the increased dependency on computational systems for improved productivity, make it imperative that this project be implemented in FY 1988.

PROJECT DESCRIPTION:

The proposed expansion of the Research Analysis Center will be a two-story brick and metal panel addition, located on the north side of the existing Building No. 42 (Figures 1 and 2 . The expansion will have a gross floor area of approximately 46,000 square feet (Figure 3).

Modifications will also be performed in the existing building to accommodate the expansion. In addition, a chiller building of 3,200 square feet will be built just west of the project. Existing HVAC, water supply, and plumbing systems will be extended to the addition. Electrical work includes power for equipment, interior and exterior lighting, and communications systems. Transformer and distribution equipment will be provided along with modification to the existing switchgear equipment. Fire protection includes installation of a pre-action sprinkler system in the operations area along with smoke detectors throughout the Computer Operations and Support Areas. Existing security systems will be extended to the addition.

The existing north service drive and the north parking lot will be reworked and expanded to accommodate the addition. An additional parking lot will be built east of the building across Walcott Road. The south parking lot will also be reworked and expanded. A total of 78 new parking spaces will be added. The site development will include landscaping, and installation and repair of lawn areas.

PROJECT COST ESTIMATE:

This cost estimate is based on a preliminary engineering report.

	Unit of Measure	Quantity	Unit cost	cost
<u>Land Acquisition</u>	---	---	---	---
<u>Construction</u>	---	---	---	<u>9,800,000</u>
Site development/utilities	LS	---	---	2,299,000
Building	---	---	---	7,501,000
Architectural/structural.....	SF	46,000	31.74	(1,460,000)
Structural.....	SF	46,000	29.25	(1,345,600)
Mechanical.....	SF	46,000	59.64	(2,743,400)
Electrical.....	SF	46,000	34.06	(1,566,800)
Security system.....	SF	46,000	8.37	(385,200)
<u>Equipment</u>	---	---	---	---
<u>Fallout Shelter</u> (not feasible)	---	---	---	---
Total.....				<u><u>9,800,000</u></u>

LIST OF RELATED GRAPHICS:

Figure 1 - Location Plan
Figure 2 - Site Plan
Figure 3 - First Floor Plan

OTHER EQUIPMENT SUMMARY:

R&D-funded noncollateral equipment costing approximately \$42,900,000 will be provided to upgrade, augment, or purchase new computers in the new addition. This equipment will be funded as follows: FY 1988 - \$9,500,000; FY 1989 - \$10,800,000; FY 1990 - \$10,800,000; FY 1991 - \$11,800,000.

FUTURE CoF ESTIMATED FUNDING REQUIRED TO COMPLETE THIS PROJECT:

No future CoF funding will be required to complete this project.

LEWIS RESEARCH CENTER
FISCAL YEAR 1988 ESTIMATES
CONSTRUCTION OF ADDITION TO THE RESEARCH ANALYSIS CENTER

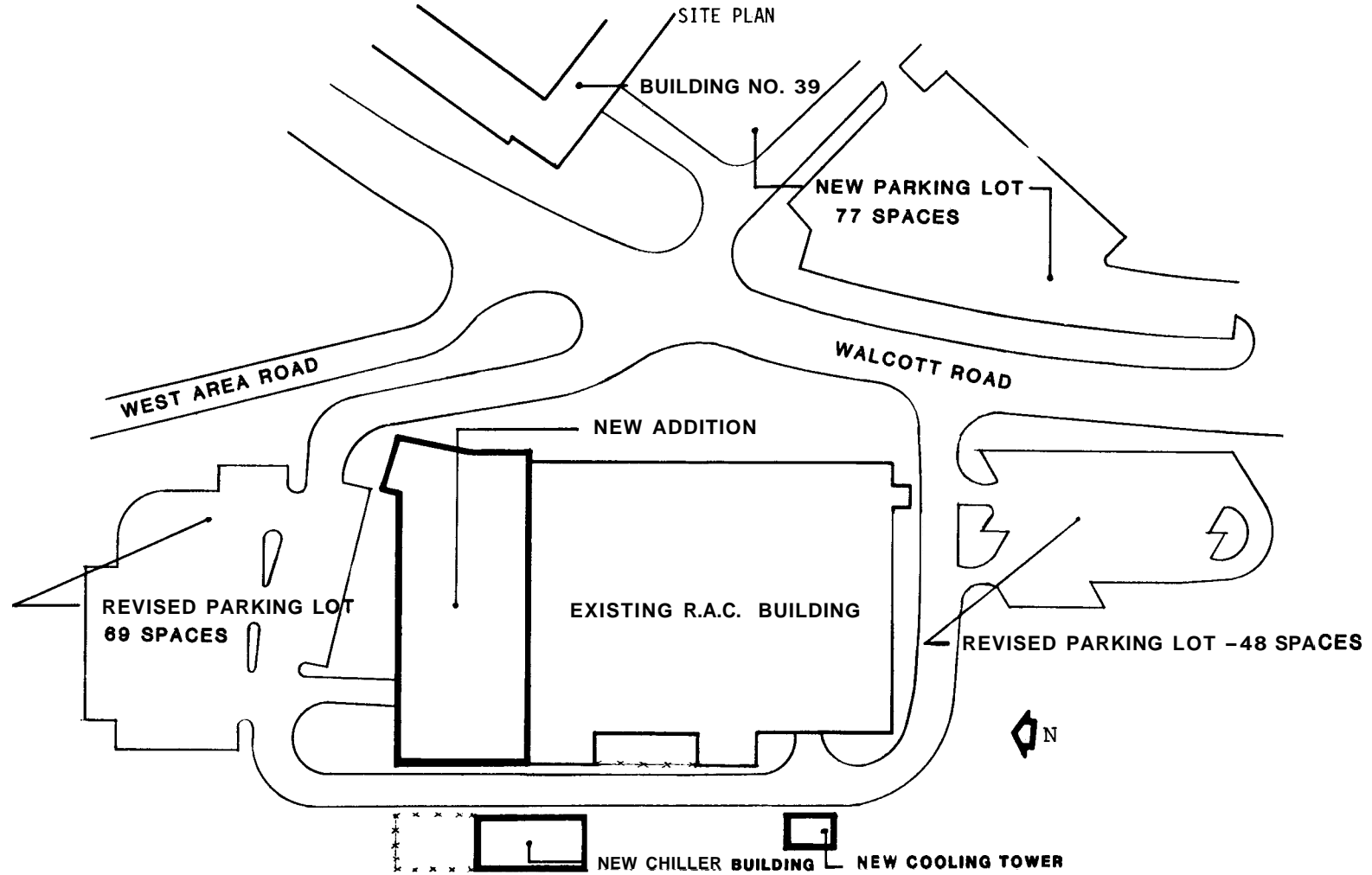


FIGURE 2

LEWIS RESEARCH CENTER
FISCAL YEAR 1988 ESTIMATES
CONSTRUCTION OF ADDITION TO THE RESEARCH ANALYSIS CENTER
FIRST FLOOR PLAN

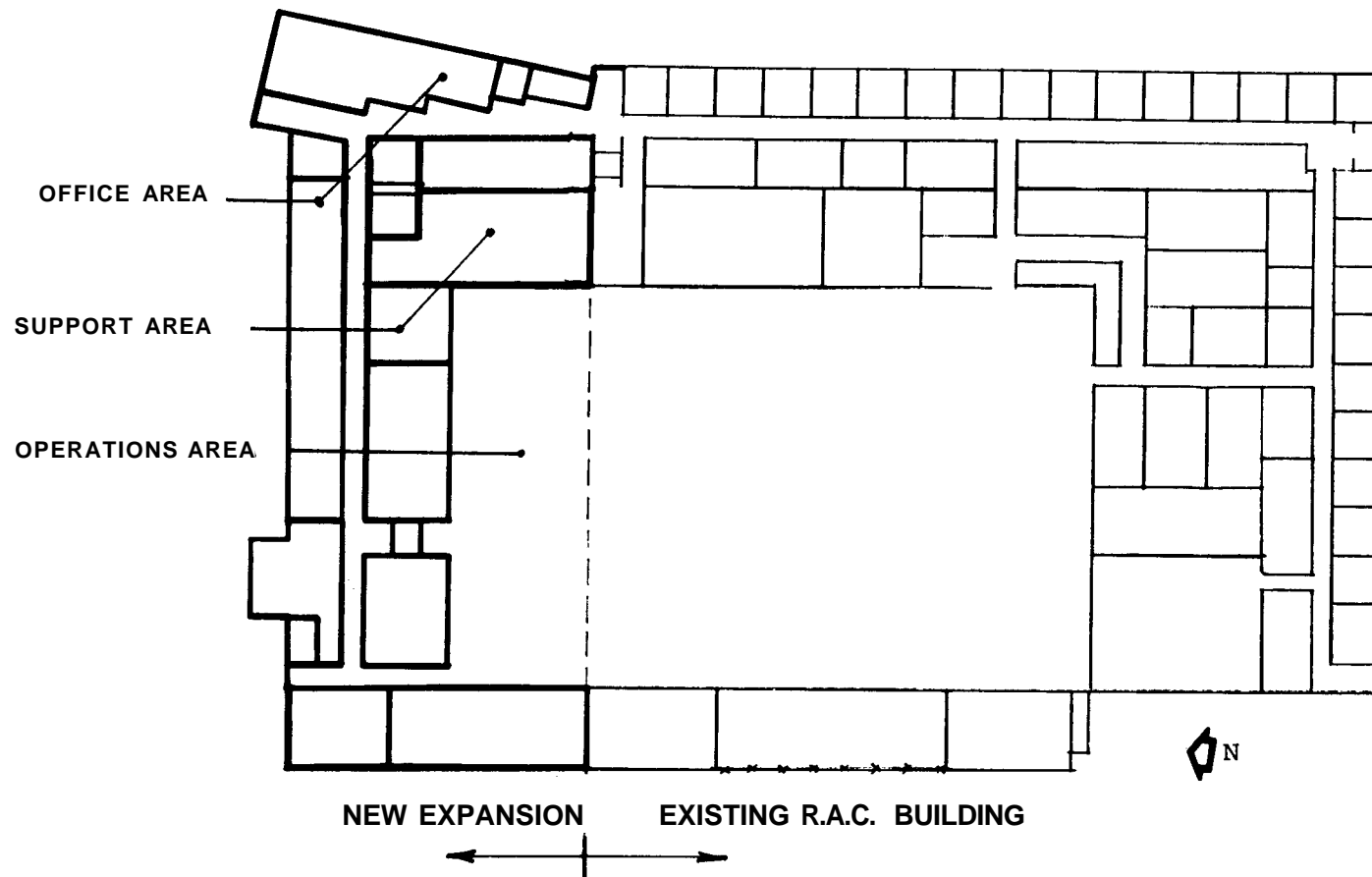


FIGURE 3

LEWIS RESEARCH CENTER
FISCAL YEAR 1988 ESTIMATES
MODIFICATIONS FOR FAN/COMPRESSOR RESEARCH,
ENGINE RESEARCH BUILDING

LOCATION PLAN

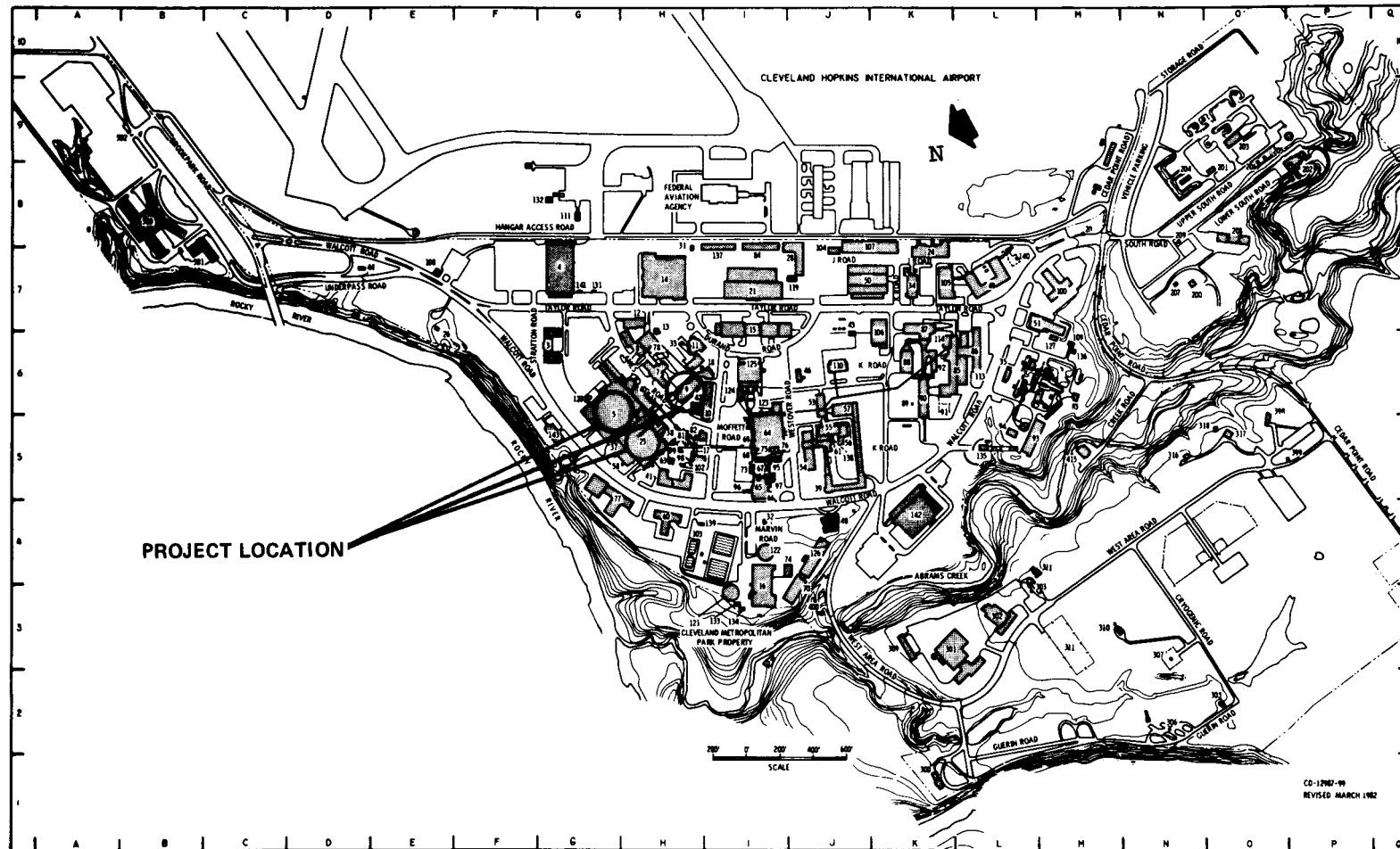


FIGURE 1

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1988 ESTIMATES

PROJECT TITLE:	<u>Modifications for Fan/Compressor Research, Engine Research Building</u>
INSTALLATION:	<u>Lewis Research Center</u>
	FY 1988 CoF Estimate: <u>\$6,500,000</u>

LOCATION OF PROJECT: Cleveland, Cuyahoga County, Ohio

COGNIZANT HEADQUARTERS OFFICE: Office of Aeronautics and Space Technology

FY 1987 AND PRIOR YEARS' FUNDING: The following prior years' funding is related to this project:

	<u>Planning and Design</u>	<u>Construction</u>	<u>Total</u>
Specific CoF funding.....	\$633,000	\$ ---	\$ 633,000
Capitalized investment.....	<u>N/A</u>	<u>17,153,000</u>	<u>17,153,000</u>
Total.....	<u>\$633,000</u>	<u>\$17,153,000</u>	<u>\$17,786,000</u>

SUMMARY PURPOSE AND SCOPE:

This project provides for modifications to Buildings 5 and 23 of the Engine Research Building (ERB) Complex and of the Refrigeration Building 9 at the Lewis Research Center (LeRC), to extend the range of high-pressure ratio compressor research by precisely controlling speed and air temperature. This capability is necessary to test a new generation of fans and compressors that are a part of the advanced gas turbine propulsion system. The project will replace and upgrade the controls and instrumentation components of the variable frequency system and will extend the refrigerated air system to the ERB complex.

PROJECT JUSTIFICATION:

This project is required to support the new generation of experimental research programs in fan and compressor research, fluid mechanics of turbomachinery and small engine component technology. Success depends on improving the efficiency, operating range, distortion tolerance, durability, weight and cost of gas turbine fans and compressors. Thus, an increased emphasis has been placed on experiments designed to better understand fan and compressor internal flow physics, phenomena associated with compressor stalling and recovery, and aeroelasticity of fans and compressors. To achieve the needed research data it is necessary to obtain a much greater accuracy of flow property measurements at higher fan/compressor pressure ratios than has been possible in the past. This greater accuracy can be accomplished by using the laser velocimeter for flow property measurements, but the speed of the research package must remain stable over longer periods of time than is now possible with the existing regulators and control system. Additionally, the air temperature must be maintained low enough to ensure fluorescence of the dye seed used to measure the flow. This project will provide a fivefold improvement in the regulation capability of the speed control system. The new regulation system will also be more reliable and easier to maintain. The present system was installed in 1940 and is controlled by outdated components which are no longer manufactured.

In addition to enhancing laser velocimeter measurements, the refrigerated air capability of this project will permit compressor test conditions to be achieved at lower physical rotative speeds of the experimental research compressor and thus lower compressor blade stress loads. The mechanical designers can also exploit the increased material strengths that occur with a reduction of inlet temperatures and better controls.

IMPACT OF DELAY:

A delay in upgrading the variable frequency system and the introduction of the refrigerated air into the ERB complex will directly affect and severely limit the experimental investigations related to fan and compressor research programs associated with advanced gas turbine propulsion systems. This delay will adversely affect the advanced technology base which allows the United States to maintain its technical advantage in gas turbine engines.

PROJECT DESCRIPTION:

This project provides for the modifications to Buildings 5 and 23 of the Engine Research Building and Building 9 (Figure 1). The modifications to the variable frequency system will provide for replacement of the 40-year-old mechanical and electrical components (motor generator sets, switchgear, contactors and relays) with present-day technology equipment. The modifications also include replacement of the existing vacuum tube variable frequency control system with a solid-state control system (Figures 2 and 3). A programmable controller which will provide master control for the regulators and control switching for parallel operation of the 1,500 kVA frequency converters is also included. Sensors for interfacing converter selection to the master control will also be added, and monitoring and control devices on existing test cell operator's panel will be replaced.

Also provided is a refrigerated air system with a flow capacity of 60 pounds per second at 10 psig pressure and minus 70°F temperature (Figure 4). The work includes the installation of a turbo expander with air compressor brake; an intercooler; related refrigeration equipment; controls and instrumentation; and refrigerated air piping between ERB and Building 9. The equipment for this refrigeration system will be located in a 1,200-square foot addition to Building 9.

PROJECT COST ESTIMATE:

This cost estimate is based on a preliminary engineering report.

	<u>Unit of Measure</u>	<u>Quantity</u>	<u>Unit cost</u>	<u>Total cost</u>
<u>Land Acquisition</u>	---	---	---	---
<u>Construction</u>	---	---	---	<u>210,000</u>
Building 9 addition for refrigerated air system...	SF	1,200	175.00	210,000
<u>Equipment</u>	---	---	---	<u>6,290,000</u>
Variable frequency system.....	---	---	---	3,680,000
Demolition.....	LS	---	---	(160,000)
Electrical equipment refurbishment/ replacement... ..	LS	---	---	(845,000)
Power converters/static exciters.....	EA	9	176,445	(1,588,000)
Convertor work	EA	9	70,222	(632,000)
Instrumentation and control system.....	LS	---	---	(455,000)
Refrigerated air system.....	---	---	---	2,610,000
Turbo expander/compressor.. ..	LS	---	---	(725,000)
Instrumentation and control system.....	LS	---	---	(440,000)
Piping.....	LS	---	---	(1,445,000)
<u>Fallout Shelter</u> (not feasible).....	---	---	---	---
Total.....				<u><u>6,500,000</u></u>

LIST OF RELATED GRAPHICS:

Figure 1 - Location Plan

Figure 2 - Site Plan - Variable Frequency System, ERB West Wing Basement

Figure 3 - Plan View - Variable Frequency System, ERB West Wing Basement

Figure 4 - Site Plan - Refrigerated Air System

OTHER EQUIPMENT SUMMARY:

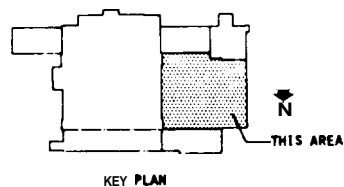
No other equipment is required to complete this project.

FUTURE CoF ESTIMATED FUNDING REQUIRED TO COMPLETE THIS PROJECT:

No future CoF funding required to complete this project.

LEWIS RESEARCH CENTER
FISCAL YEAR 1988 ESTIMATES
MODIFICATIONS FOR FAN/COMPRESSOR RESEARCH,
ENGINE RESEARCH BUILDING

VARIABLE FREQUENCY SYSTEM, ERB WEST WING BASEMENT
SITE PLAN



A = ELECTRICAL SWITCHGEAR
B = ROTARY ELECTRICAL EQUIPMENT

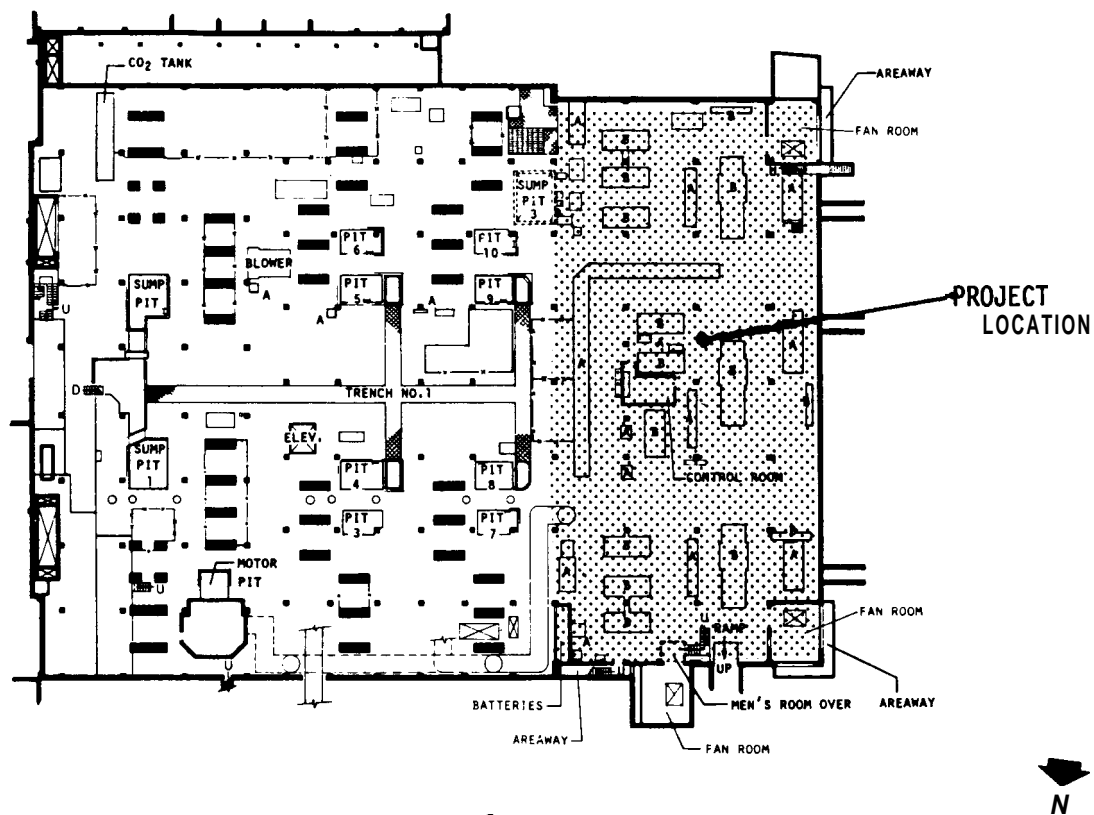
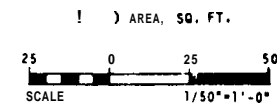


FIGURE 2



LEWIS RESEARCH CENTER
FISCAL YEAR 1988 ESTIMATES
MODIFICATIONS FOR FAN/COMPRESSOR RESEARCH,
ENGINE RESEARCH BUILDING

PLAN VIEW VARIABLE FREQUENCY SYSTEM - ERB WEST WING BASEMENT

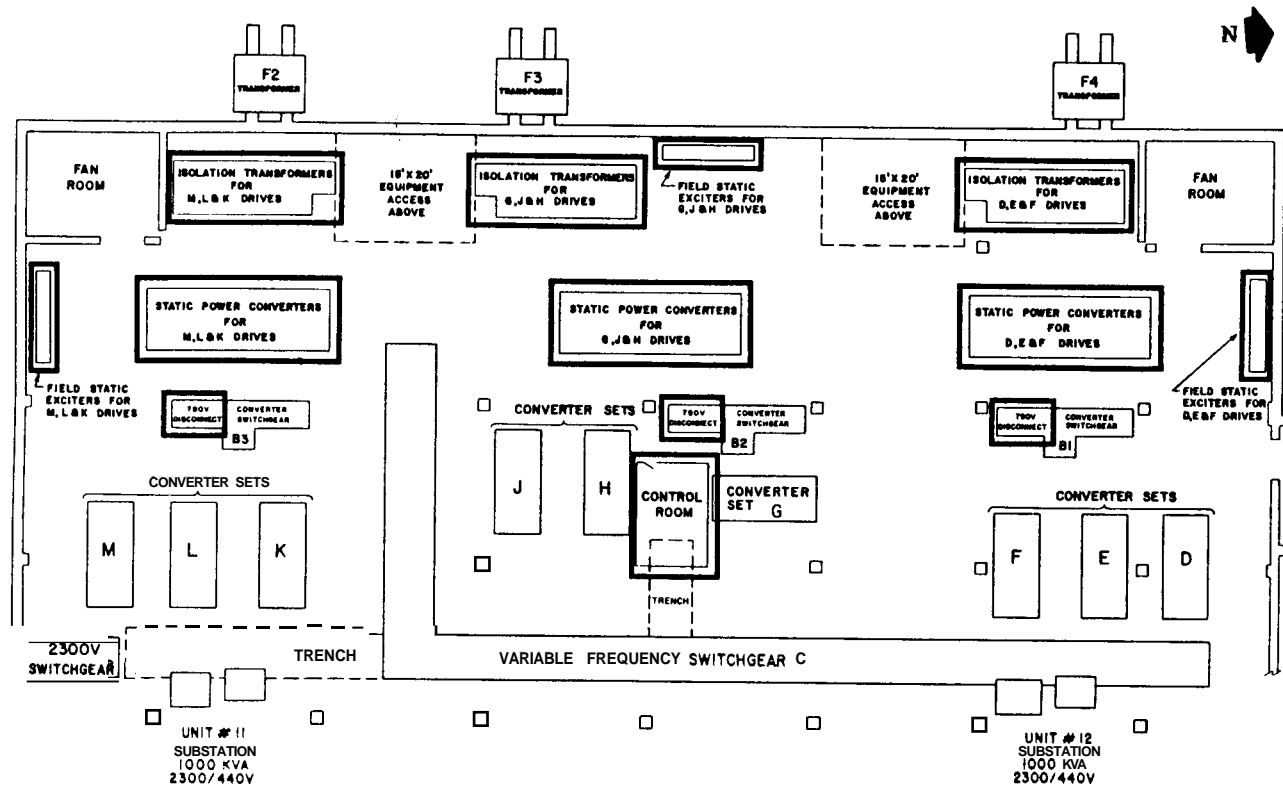


FIGURE 3

LEWIS RESEARCH CENTER
FISCAL YEAR 1988 ESTIMATES
MODIFICATIONS FOR FAN/COMPRESSOR RESEARCH
ENGINE RESEARCH BUILDING

REFRIGERATED AIR SYSTEM

SITE PLAN

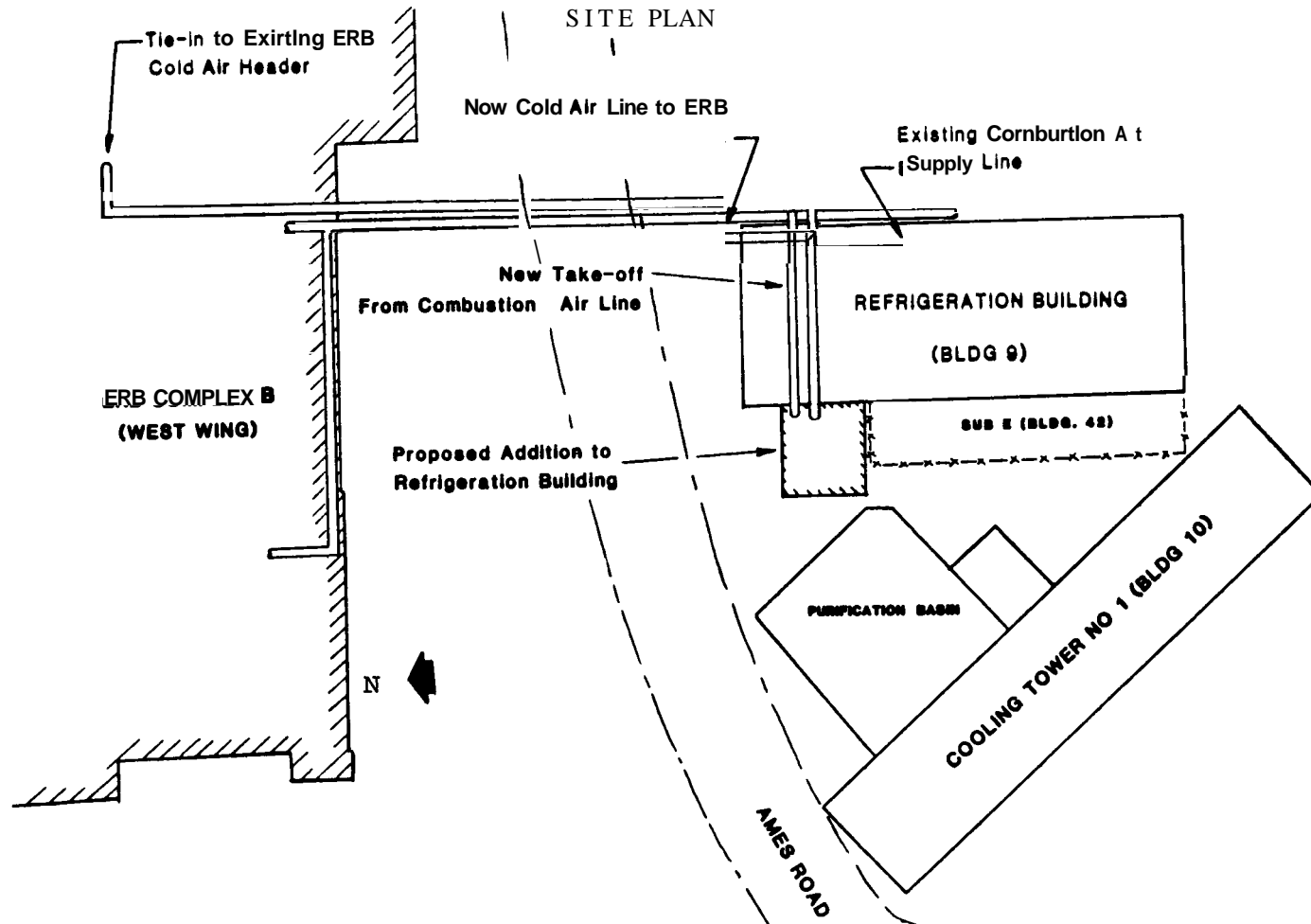


FIGURE 4

VARIOUS LOCATIONS



NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1988 ESTIMATES

SUMMARY

VARIOUS LOCATIONS

Office of Space Tracking and Data Systems:

Amount

Page No.

Construction of Communications Development Antenna, Goldstone, CA.....

6,400,000

CF 7-1

VARIOUS LOCATIONS
FISCAL YEAR 1988 ESTIMATES
CONSTRUCTION OF COMMUNICATIONS DEVELOPMENT ANTENNA, GOLDSTONE, CALIFORNIA

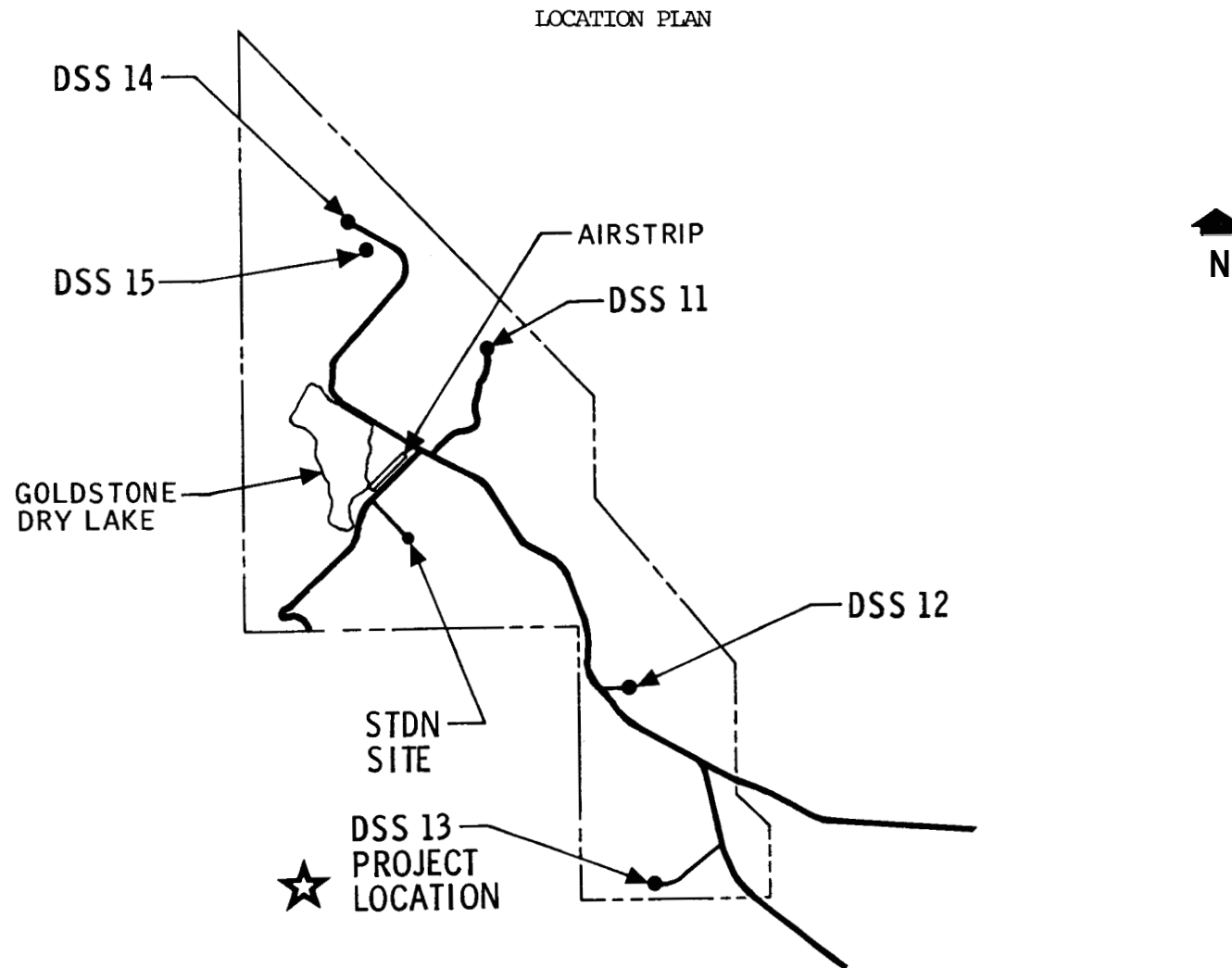


FIGURE 1

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1988 ESTIMATES

PROJECT TITLE:	Construction of Communications Development Antenna, Goldstone, California
INSTALLATION:	Jet Propulsion Laboratory
	FY 1988 CoF Estimate: \$6,400,000

LOCATION OF PROJECT: Goldstone, California

COGNIZANT HEADQUARTERS OFFICE: Office of Space Tracking and Data Systems

FY 1987 AND PRIOR YEARS' FUNDING: The following prior years' funding is related to this project:

	<u>Planning and Design</u>	<u>Construction</u>	<u>Total</u>
Specific CoF funding.. ..	\$384,000	---	\$384,000
Capitalized investment.....	N/A	N/A	N/A
Total.....	<u>\$384,000</u>	<u>\$ N/A</u>	<u>\$384,000</u>

SUMMARY PURPOSE AND SCOPE:

This project provides for the construction of a high-efficiency 34-meter Deep Space Network (DSN) development antenna at the Goldstone Deep Space Communications Complex, and will replace the existing obsolete 26-meter development antenna. The 34-meter antenna will allow development of high-efficiency transmitting and receiving capabilities at Ka-band and improvement in antenna pointing. These improvements will significantly increase spacecraft tracking data rates and navigation precision as well as enhance radio science measurement capabilities.

PROJECT JUSTIFICATION:

During the last 20 years, as spacecraft have traveled further from Earth, the space communications requirements have become increasingly stringent. As the distances associated with existing and future spacecraft missions increase, the ability to achieve the high data rates and wideband telecommunications necessary for precise tracking, navigation and control, and for acceptable science return is severely constrained.

To improve the performance and cost-effectiveness of telemetry transmission, higher radio frequencies are needed. Upgrading of the DSN to operate at these higher radio frequencies (Ka-band) is required now so that developments can be incorporated into the DSN in the 1990s. This upgrading must make maximum use of existing DSN investments. The 34-meter high-performance antenna will enable this development to take place and will also permit improved microwave optics, low noise amplifiers, and beam waveguide systems that will be applicable to existing DSN antennas. It will also be used to develop enhancements in antenna efficiencies at X-band frequencies which can be transferred effectively and economically to other DSN antennas due to the similarity of basic antenna designs.

In addition, this new antenna will provide a means for development and demonstration of high-reliability cryogenic cooling systems for low noise amplifiers, improved frequency and timing systems, and for increasing the efficiency of higher frequency radio transmitting and receiving equipment and techniques. Advancements for the DSN that are anticipated from use of this antenna include increased capability for data return, improved tracking for more precise spacecraft navigation and control, and improvements in DSN Radio Science measurements. This antenna can also provide a backup to the high-power transmitter at the Goldstone Deep Space Station (DSS) 14 for commanding of spacecraft for navigational and operational maneuvers.

This antenna will replace the existing Goldstone DSS 13, 26-meter development antenna, which will be 29 years old and cannot be modified to operate at frequencies higher than X-band. The existing 26-meter antenna will be dismantled.

IMPACT OF DELAY:

This project is required in the FY 1988 program to ensure that Ka-band and other developments can be completed in time to upgrade the DSN beginning in the early 1990s for higher frequency operations. Continued spectrum crowding, the need for more precise navigation and control, and for higher rates of data return involving spacecraft missions to the outer planets and beyond, require that the technological developments made possible by this antenna be started now.

PROJECT DESCRIPTION:

This project provides for the construction of a new configuration, high-performance 34-meter wheel and track type, azimuth-elevation antenna. It will be located at Goldstone immediately adjacent to the site of the existing DSS-13 26-meter development antenna, and will be site-adapted to use existing facilities and utilities.

This project includes the installation of the antenna structure, mechanical drives and controls, and beam waveguide as well as the construction of the foundation and antenna-mounted equipment enclosures. Also included in this project is the construction of a 2,000-square foot concrete block building to provide engineering offices, laboratories, shops, and storage which are now located in six badly deteriorated trailers.

PROJECT COST ESTIMATE:

This cost estimate is based on a preliminary engineering report.

	<u>Unit of Measure</u>	<u>Quantity</u>	<u>Unit cost</u>	<u>cost</u>
<u>Land Acquisition</u>	---	---	---	---
<u>Construction</u>	---	---	---	<u>6,286,000</u>
Antenna construction and mechanical.....	LS	---	---	5,983,000
Sitework and utilities.....	LS	---	---	183,000
Support building.....	SF	2,000	60.00	120,000
<u>Equipment</u>	---	---	---	<u>114,000</u>
Government-furnished equipment.....	LS	---	---	<u>114,000</u>
<u>Fallout Shelter</u> (not feasible).....	---	---	---	---
<u>Total</u>				<u>6,400,000</u>

LIST OF RELATED GRAPHICS:

Figure 1 - Location Plan
Figure 2 - Site Plan
Figure 3 - Elevation

OTHER EQUIPMENT SUMMARY:

Developmental antenna equipment and related engineering support required to make the antenna initially operable will be provided with \$3,700,000 of Research and Development (R&D) funds and \$2,000,000 of Spaceflight Control and Data Communications (SFC&DC) funds respectively.

FUTURE CoF ESTIMATED FUNDING REQUIRED:

No future CoF funding will be required to provide an initially usable facility.

VARIOUS LOCATIONS
FISCAL YEAR 1988 ESTIMATES
CONSTRUCTION OF COMMUNICATIONS DEVELOPMENT ANTENNA, GOLDSTONE, CALIFORNIA

SITE PLAN

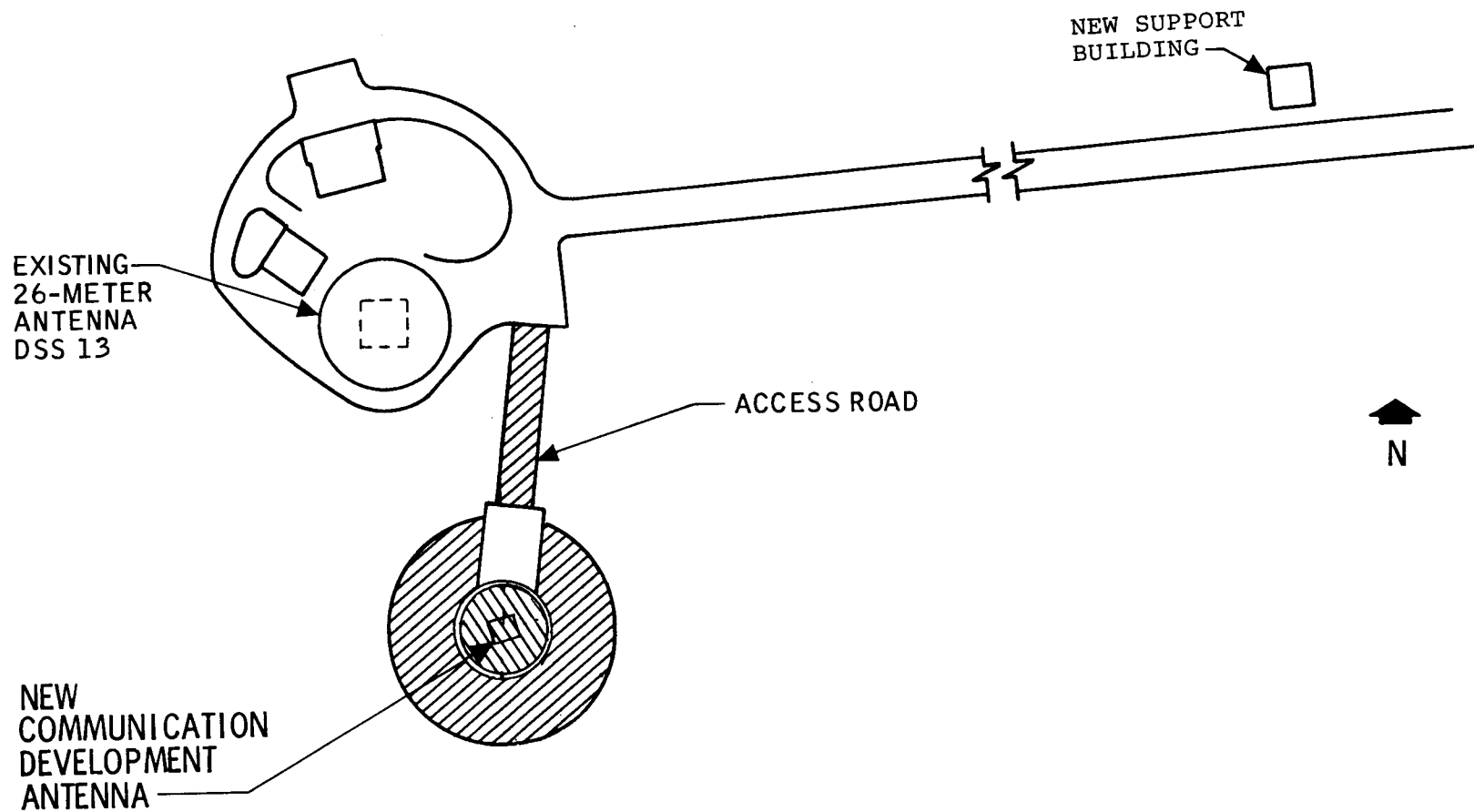


FIGURE 2

VARIOUS LOCATIONS
FISCAL YEAR 1988 ESTIMATES
CONSTRUCTION OF COMMUNICATIONS DEVELOPMENT ANTENNA, GOLDSTONE, CALIFORNIA

ELEVATION

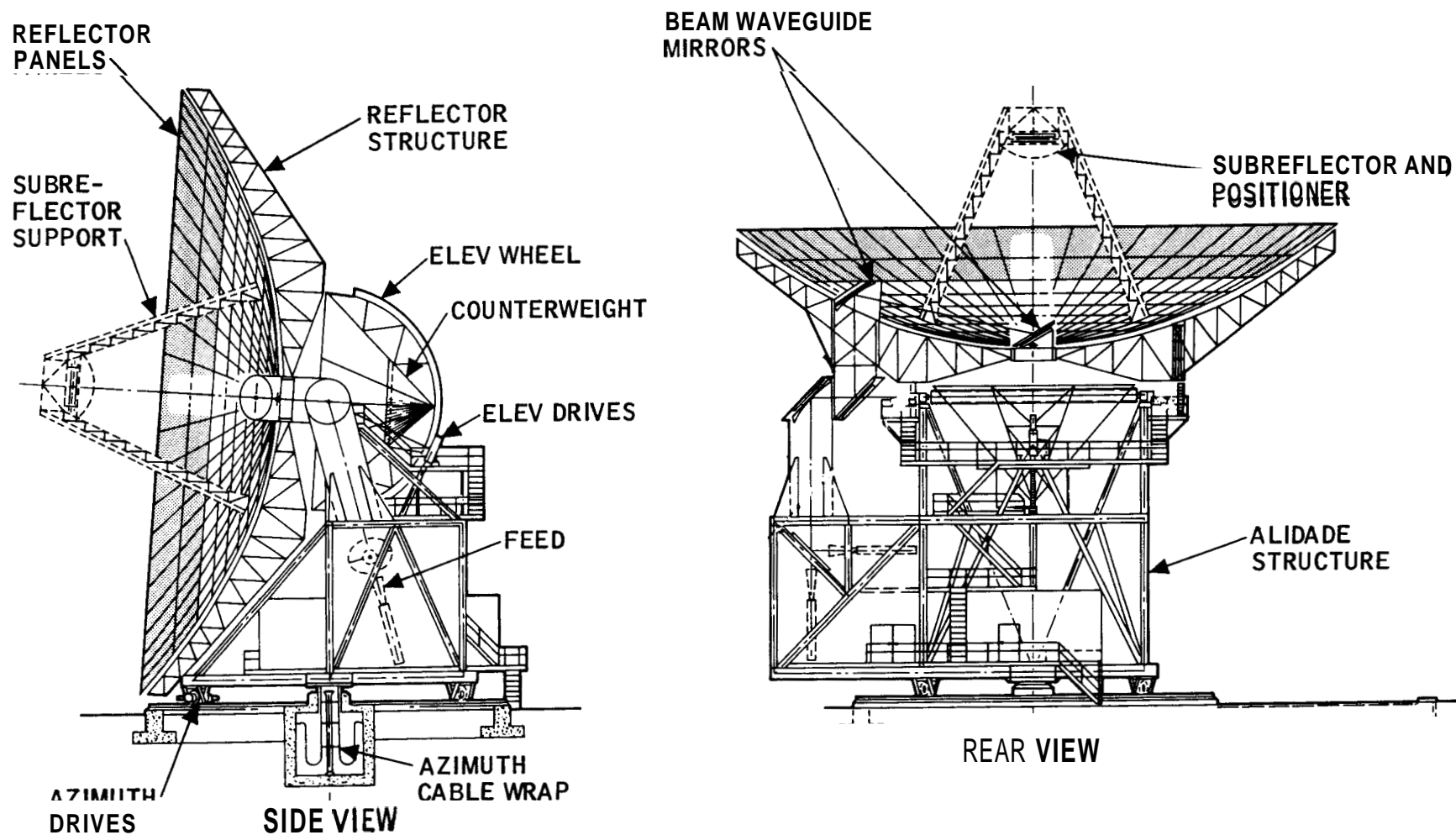


FIGURE 3

— 2151

REPAD



NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1988 ESTIMATES

SUMMARY

REPAIR

Summary of Project Amounts by Location:

	<u>Amount</u>	<u>Page No.</u>
Ames Research Center	1.960. 000	CF 8-3
Dryden Flight Research Center	240. 000	CF 8-4
Coddard Space Flight Center	2.300. 000	CF 8-4
Jet Propulsion Laboratory	1.380. 000	CF 8-6
Johnson Space Center	2.060. 000	CF 8-7
Kennedy Space Center	2.845. 000	CF 8-8
Langley Research Center	3.150. 000	CF 8-10
Lewis Research Center	2.850. 000	CF 8-11
Marshall Space Flight Center	2.290. 000	CF 8-13
Michoud Assembly Facility	1.030. 000	CF 8-14
National Space Technology Laboratories	2.220. 000	CF 8-14
Wallops Flight Facility	1.570. 000	CF 8-15
Various Locations	210. 000	CF 8-17
Miscellaneous Projects Not Exceeding \$150.000 Each	<u>895. 000</u>	CF 8-17
Total	<u><u>25.000. 000</u></u>	

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1988 ESTIMATES

PROJECT TITLE:	<u>Repair of Facilities, Not in Excess Of \$750,000 Per Project</u>		
INSTALLATION:	<u>Various Locations</u>		
	FY 1988 CoF ESTIMATE:		<u>\$25,000,000</u>
	FY 1986: \$22,000,000	FY 1987: \$24,000,000	

COGNIZANT INSTALLATIONS/LOCATIONS OF PROJECT: Various Locations

COGNIZANT HEADQUARTERS OFFICE: Office of Management

SUMMARY PURPOSE AND SCOPE:

These resources will provide for large repairs to facilities at NASA field installations and Government-owned industrial plants supporting NASA activities. Included in the request are those facility repair needs for FY 1988 that can be foreseen at the time of the submission of these estimates, and are not to exceed \$750,000 per project. The thrust of this program is to provide a means to restore facilities or components thereof, including collateral equipment, to a condition substantially equivalent to their originally intended and designed capability. The request includes the substantially equivalent replacement of utility systems and collateral equipment necessitated by incipient or actual breakdown. This work also includes major preventive measures which are normally accomplished on a cyclic schedule of greater than 1 year.

PROJECT JUSTIFICATION:

A major portion of the Agency's facilities exceeds 20 years in age, and increases in repair requirements are to be expected. Maintenance and repair costs for mechanical and electrical systems in a typical building are almost three times higher during the 16- to 30-year period of a building's life than they are during the

initial 15 years of beneficial occupancy. At about the 15-year point, many electrical and mechanical components reach the end of their serviceable or economic life and should be replaced in the interest of long-term economy. Continued piecemeal repair of these components usually requires more resources in the long run than replacement after the end of the economic life of the original components. Approximately 75 percent of the physical plant is in the 16- to 30-year old category.

The major thrust of this repair program, as well as the rehabilitation and modification programs, is to preserve the Agency's \$4.0 billion (as of September 30, 1986) physical plant. The major distinction between these classes of work is whether or not the intended work is to bring the facility and its components to a condition substantially equivalent to its designed capacity, efficiency, and capabilities. If such is the case, the work is classified as repair. An analysis of each of the projects for which funds are requested indicates that this work must be addressed and progressively accomplished. Otherwise, risks are increased and future costs of the specific work will be greater. More importantly, there will be increased breakdown and costly unscheduled repairs required.

This program includes only facility repair work having an estimated cost not in excess of \$750,000 per project. The work is of such a nature and magnitude that it cannot be accomplished by routine day-to-day facility maintenance and repair activities, or by related routine facility work efforts that are provided for in other than CoF estimates. A repair project, estimated to cost more than \$750,000, would be reflected elsewhere as a separate major line item project.

PROJECT DESCRIPTION:

Proposed repair projects for FY 1988 totaling \$25,000,000 are described under "PROJECT COST ESTIMATE." Projects estimated to cost not in excess of \$150,000 have not been individually described or identified by Center, and the total request for these projects is \$895,000. This repair program has been distilled from requests for FY 1988 exceeding \$50,000,000, and thus represents a modest request in relation to the continuing backlog of this type of work. Based on relative urgency and expected return on investment, the projects which comprise this request are of the highest priority. Deferral of this mission-essential work would adversely affect the availability of critical facilities and program schedules.

During the course of the year, it is recognized that some rearrangement of priority may be necessary. This may force a change in some of the items to be accomplished. Any such change, however, will be accomplished within total available repair resources. The following broad categories of work are described further in the "PROJECT COST ESTIMATE":

a. Utility Systems.	11,300,000
b. General Purpose Buildings.	3,200,000
c. Technical Buildings/Structures.	4,900,000
d. Pavements and Drainage.	2,000,000
e. Building Exteriors and Roofs.....	3,600,000

PROJECT COST ESTIMATE:

A. <u>Ames Research Center</u> (ARC).....	<u>\$1,960,000</u>
1. Repair of Pressure Vessels, Various Locations.....	240,000

This project will repair five 75-foot diameter vacuum spheres at N-229 and N-231, the 60 MW interaction facility at N-238, and the 20 MW panel facility at N-238. Work will include radiographic inspection, weld replacement, pipe and valve replacement, and new support structures as required. These facilities have been identified as needing repair as part of the ongoing pressure vessel recertification program at Ames.

2. Repair of 11 X 11-Foot Transonic Wind Tunnel.....	740,000
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This project provides for the second of three phases to replace the tunnel after cooler coils. Approximately one-third of the coils will be replaced by this effort. The coils are over 25 years old and corrosion leaks are such that repair is no longer feasible. If not replaced the compressor lube oil could become contaminated by the cooling water which would cause serious damage to the compressor bearings and cause air flow quality deterioration due to "hot spots" in the air stream.

3. Repairs to the Bioscience Laboratory, N-236	740,000
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This project provides for the repair of approximately 56,000 square feet of built-up roof at Building N-236. Also included will be new roof drains, flooding, and mechanical equipment supports. The present roof is over 15 years old and spot repairs are no longer possible. The project also provides for the replacement of an existing unreliable emergency power supply with two new 60 kW diesel generators to provide backup power

to support animal care during emergency periods. Without a reliable backup power supply, ARC stands in jeopardy of losing accreditation by the American Association of Laboratory Animal Care.

4. Repair of Steam Generators, and Heat Exchangers 240,000

This project provides for the replacement of a 75 HP. steam generator and for the repair of six interstage heat exchangers serving the air compressors at N-229A. The steam generator and heat exchangers, are no longer reliable due to age and deterioration. The air compressors supply 3,000 psig air to many of the Center's wind tunnels. Therefore, in order to support program requirements, it is essential that this equipment be highly reliable.

B. Dryden Flight Research Facility (DFRF) \$240,000

1. Repair of Security and Fire Protection Systems, Various Locations..... 240,000

This project provides for the replacement of multiplex alarms and supervisory reporting systems that have become obsolete and difficult to maintain. Also the existing systems are inadequate to handle the number of points required to provide proper fire and security supervision. The present system can only accommodate 288 points. A new CPU system is needed that is capable of accepting 850 signal codes that are now needed with a future expansion capability to 2,000 points.

C. Goddard Space Flight Center (GSFC) \$2,300,000

1. Replace Elevators, Various Buildings 600,000

This project provides for the replacement of six elevators; two cars in the Administration Building No. 8; one car each in the Logistics and Supply Facility, Building 16, and the Payload Testing Facility, Building 7; and two cars in the Space and Terrestrial Application Facility, Building 22. This replacement work includes the elevator cabs, doors, controls, related equipment, and all worn parts. Provisions for the handicapped and emergency fireman access are also included. These elevators must be replaced to provide adequate service in the buildings. These passenger/freight elevators have been in constant use since the 1960s and are frequently out of service and downtime is excessive because of the difficulty in obtaining parts for the outdated equipment.

2. Repair Electrical Systems, Buildings 18 and 26..... 300,000

This project provides for the rehabilitation of the electrical systems in Administrative Support Building 18 and Space Science Data Center, Building 26. In Building 18 the work includes replacement of the switchgear including rearrangement of the primary load switches; replacement of the main breakers and load distribution centers; installation of automatic tie breakers; and modification of existing mechanical equipment room. In Building 26 the work includes repair and upgrading of the two existing main breakers to solid state type and the conversion of existing manual tie system to automatic tie system. The existing electrical equipment in these buildings was installed in the early 1960s, and because of growing electrical requirements, the existing equipment can no longer support all the functions satisfactorily. This project will restore reliability to an aging electrical system.

3. Repair Roofs, Buildings 1 and 16..... 460,000

This project provides for replacement of 49,000 square feet of roofing on the Space Projects Building 1 and the Logistics and Supply Facility Building 16 (office wing). The work includes replacement of existing roof coping, flashings, and gravel stop. The existing roofs are more than 20 years old and contain numerous patches and temporary repairs. Proposed work will restore facility integrity and minimize potential Government property loss due to water damage.

4. Repair Air-Handling Units, Buildings 7 and 10..... 400,000

This project provides for the repair of eight Air-Handling Units (AHU) in the Payload Testing Facility, Building 7, and the Environmental Testing Laboratory, Building 10. Work includes the repair of deteriorated insulation; replacement of the associated corroded plenum, ductwork, piping, defective dampers; and updating of automatic temperature control instrumentation panel as necessary within the immediate vicinity of the air-handling equipment. Existing piping/equipment insulation which requires repair work will be removed to the extent that is necessary. The existing package/built-up air-handling units have been in operation since the early 1960s. Because of deterioration and corrosion resulting from their vintage and extensive operations, replacement of equipment components or the entire unit has become necessary.

5. Repair Pressure Systems, Various Buildings..... 210,000

This project provides for repairing 13 liquid nitrogen (LN₂) storage, vaporization facilities located at Buildings 4, 7, 10, 11, 15, 21, and 22. The work includes repairing footings, insulation repair, general structural, mechanical, and concrete work, roof work, and rust protection. In addition, rust protection will be provided for the freon storage tank at Building 24; two air receivers will be replaced at Building 5; and

eight trailer-mounted LN₂ systems at Buildings 5, 6, and 7 will be repaired. This project is required to restore the pressurized systems to allow their continued use in the future. Failure to repair these systems now will result in accelerated deterioration and unsafe conditions.

6. Replace Steamlines from Manhole 9A to Buildings 12 and 17..... 330,000

This project provides for the replacement of approximately 1,300 linear feet of steam supply, condensate return, and housing with preinsulated, direct burial piping. This run consists of 1,200 feet of 4-inch steam, 800 feet of 2-1/2 inch condensate, 100 feet of 2-inch steam and 1-inch steam and 1-inch condensate interconnecting steam manhole 9A, the Tracking and Telemetry Laboratory (12) and the Administrative Support Building (17). Also included in this project is the installation of steam siphon jets for 30 Center steam manholes. This steam and condensate line was installed in the early 1960s and has numerous leaks in the steel housing due to severe corrosion. The replacement work will improve cathodic protection, minimize capacity loss and maintenance costs. The installation of siphon jets is required to improve working conditions and to prevent damage to piping and insulation due to submersion of the line in groundwater.

- D. Jet Propulsion Laboratory (JPL)..... \$1,380,000

1. Repair Storm ~~Dairs~~..... 710,000

This project provides for the application of a cement-mortar lining to approximately 10,000 linear feet of worn out and rusted corrugated metal pipe storm drains throughout JPL. The pipe sizes vary from 6" to 60". The pipes will be cleaned and holes patched prior to application of the lining. In addition, a section of the storm drainage channel northeast of Building 298 will be repaired and the inlet modified to prevent undermining of the channel and damage to that building. Cracked and undermined drainage channels adjacent to Mesa and Pioneer Roads will also be repaired. These storm drains are 20 to 35 years old. This work needs to be done to prevent further storm drain line damage and deterioration as well as to improve the hydraulic characteristic of the corrugated metal pipe. The storm diversion channels near Building 298 must be repaired because of the potential for recurrent damage to the building and surrounding terrain.

2. Repair Exteriors, Various Buildings..... 330,000

This project provides for the repair and exterior sealing of the Technical Information Building (111); Computer Program Office (156); Cafeteria (167); 10-foot Space Simulator Building (248); Space Flight Support Building (264); and Isotope Thermoelectric Systems Applications Laboratory (277). The present exterior surfaces, 1970 vintage, are long overdue for recoating, repairing, and applicable procedures to bring them up to a satisfactory condition. Caulking and flashings around the windows and other openings have dried out and

cracked, permitting the entrance of rain water. Insulated panels on Building 167 have cracked and buckled, allowing water penetration and subsequent decomposition. The work involves the exterior coating/waterproofing of approximately 142,000 square feet of wall surface. Additionally, the damaged and water-buckled insulated curtain wall panels on Building 167 will be removed and replaced.

3. Repair of "C" Stand, Edwards Test Station... 340,000

This project will provide for the repairs to the communication, oxidizer supply and vacuum systems at Test Stand "C", Edwards Test Station for testing propulsion engines/modules and altitude thrusters. The tests include performance verification of contractor's data, tests of modifications to specific equipment items and duplication of flight anomalies for possible correction. Liquid propellant work has been concentrated at "C" Stand which requires the repair and consolidation of functions relating to the oxidizer (N_2O_4) being supplied to the vacuum vessel, remote control of the steam-driven vacuum pumping system and repair of operational communications between the stand and blockhouse. The result of these repairs will be the separation and abandonment of "D" Stand controls and instrumentation wiring and the consolidation of all testing at the "C" Stand.

E. Johnson Space Center (JSC)..... \$2,060,000

1. Repair of Utility Generation and Distribution System..... 350,000

This project is part of a continuing program to repair the utility generation equipment located in the central heating and cooling plant, Building 24, and the emergency power Building 48 (supporting the mission control center) and their associated distribution systems. The timely repair of the generation equipment and utility distribution systems is essential to maintaining the reliability, efficiency, and safety of the basic site and critical mission support activities. Work will include the repair of boilers, water chillers, engine generators, heat exchangers, and cooling tower fans and pumps. Work on the utility distribution system includes the repair/replacement of pipe insulation, expansion joints, valves, and various controls.

2. Repair of Heating, Ventilating, and Air-conditioning System, Various Buildings... 500,000

The project is part of a continuing program to repair heating and cooling equipment in various buildings at JSC. The project is required because of the age of the pieces of equipment which are approaching the end of their useful life expectancy, and the high humidity and salt/chemical content of the air in this region which corrodes the equipment. Work will include the repair of chilled water air handlers, direct expansion air handlers, air compressor, cooling tower, chiller units, and their associated equipment. The area of concentration includes Buildings 4, 5, 8, 9, 400 series buildings, and the thermochemical test area.

3. Repair Electrical Substations, Various Buildings..... 460 ,000

This project provides for the removal of existing deteriorated air-type, high-voltage switches and the installation of dual circuit, primary selective loop type input, fused load-break, oil-filled switches at Buildings 1, 3, 7, 31, 34, 37, and 222. The work is necessary because the existing electrical equipment in the building substations is over 23 years old and is deteriorating. Replacement parts for these old switches are no longer available. If the equipment is not replaced, the substation reliability will degrade JSC's programs.

4. Repair Cafeteria Ceiling, Building 11..... 400 ,000

This project provides for the replacement of approximately 8,500 square feet of water-damaged textured ceiling in the main cafeteria, Building 11. The existing ceiling is water-damaged in many areas, causing the plaster to slough off when dried, thereby creating a potential safety hazard. Work will include installing new lay-in acoustical ceiling, new flush-mounted light fixtures, and modifications to the existing air-conditioning ducts.

5. Repair of 15-kV Power Cable Tunnel System..... 350,000

This project provides for repair by replacement of electric power feeder 2-7 in the utility tunnel system. The work includes the replacement of approximately 6,500 linear feet of 15kV cable servicing Buildings 1, 2, 3, 13, 14, 15, 16, 16A and 17. This electrical power cable has been in continuous operation for 20 years. Recently, numerous unscheduled outages have occurred because of faults in the cable system. Examination of the cable indicates that replacement is required to ensure electrical power reliability to the critical facilities served by this cable system.

F. Kennedy Space Center (KSC)..... \$2,845,000

1. Repair Built-up Roof System, KSC Headquarters Building..... 230 ,000

This project provides for the repair of approximately 40,000 square feet of 5-ply built-up roofing on the KSC Headquarters Building. The work includes removal of gravel, felts and insulation, repair of base flashing at walls, installation of new insulation and built-up asphaltic felt roofing, and replacement of gravel. Periodic roof maintenance has been performed, but the extensive accrued deterioration requires complete replacement of the roofing to provide cost-effective protection of the building and contents.

2. Repair NASA Parkway East-Bound Lanes, Gate 3 to Kennedy Parkway... 600,000

This project will repair approximately 7.5 miles of the east-bound lanes of NASA Parkway from Gate #3 to the Kennedy Parkway. Approximately 3,080 tons of asphaltic concrete will be required as a leveling course along several sections of the road due to settling of the road bed. A 1-inch asphaltic concrete overlay will be applied to some 102,800 square yards of pavement with 115,700 lineal feet of pavement striping. NASA Parkway is the main east/west access to KSC and is more than 20 years old. It is subjected to excessive traffic including heavy equipment. At the present time, deterioration consists of cracks forming in the wearing surface causing roughness and settlement in some sections. Accelerated deterioration of the road bed can be expected if surface repairs are deferred.

3. Repair Rooftop Air Handlers on Central Instrumentation Facility (CIF)..... 380,000

This project will replace four built-up plenum air-handler units on the CIF roof with new energy-efficient units, rooftop ductwork and associated piping. The existing air-handler units have exceeded their normal life expectancy and are deteriorating due to the harsh environmental conditions. This situation jeopardizes the units' reliability with adverse affects on computer operations resulting from unscheduled outages.

4. Repair Roof on Launch Equipment Shop (LES). 210,000

This project replaces approximately 34,000 square feet of 5-ply built-up roofing on the LES. The work includes removal of existing roofing materials, inspection to identify undisclosed conditions, deck repair as necessary, installation of new multiply built-up roofing, and repair of base flashing and gutters. The existing roof membrane has been in service for 20 years and has lost its flexibility. Complete replacement is the only cost-efficient roofing solution for this facility which houses contractors performing Shuttle related work in support of launch activities.

5. Repair High Temperature Hot Water (HTHW) Lines East of Central Heat Plant..... 700,000

This project provides for the replacement of the existing below grade sections of Zones 1, 2, and 3 main lines of the Industrial Area HTHW distribution system located between 2nd Street and 3rd Street. Replacement piping will incorporate cathodic protection and new insulation. The existing piping is highly corroded and the insulation has deteriorated with the resultant high heat loss and increasing failure rate. These main lines are required to provide reheat (humidity control) and heat to Shuttle cargo and launch critical facilities in the Industrial Area.

6. Replace Air Handlers and Roofing at SAEF-2..... 725,000

This project will replace six air handlers at SAEF-2 with five new energy-efficient units and replace approximately 13,000 square feet of colocated built-up roofing. The project also includes new piping, chilled water pumps and a secondary hot water system. The existing units are old and have deteriorated due to the harsh environmental conditions. Because payload processing operations are supported by this air-conditioning system, the reliability for Shuttle users will be jeopardized by the increasing maintenance downtime.

G. Langley Research Center (LaRC) \$3,150,000

1. Replace Roof Gas Dynamics Lab (1247D)..... 500,000

This project provides for the replacement of approximately 30,350 square feet of coal tar built-up roof at Building 1247D. The work to be accomplished will include removing the existing roof and installing a new roof from the deck upwards. The new materials will include insulation, flashing, and all other items necessary to restore the roof to its original condition. The present roof leaks and can no longer be economically maintained.

2. Repair of High-pressure Piping Systems, Various Locations..... 500,000

This project provides for repairs to the high-pressure oxygen, nitrogen, hydrogen, sylene, methane, and hydraulic systems in Building 1221; the high-pressure air systems in Building 1267; and the vacuum and high-pressure hydraulic, cryogenic, and hydrogen systems in Buildings 1247B and 1247D. The work to be done under this project includes the replacement of defective piping, valves and fittings, inspection of welds, and repair of defective welds. These systems have been identified for repair as part of the LaRC's Recertification program.

3. Repairs to High-pressure Steam System, West Area..... 550,000

This project provides for repairs to the high-pressure steam distribution system in the West Area. The work to be accomplished under this project includes the replacement of defective piping, valves and fittings, radiographic inspection of welds, and repair of defective welds. The need for these repairs were identified under LaRC's Recertification program.

4. Repairs to the Hypersonic CF₄ Tunnel..... 550,000

This project provides for the replacement of the existing nozzle and test section windows and for modifications to the injection/support system in the Hypersonic CF₄ Tunnel, Building 1275. The work

accomplished under this project will facilitate changes to angle-of-attack settings during a tunnel run, and restore proper flow characteristics in the tunnel test section thus improving productivity and operational capability. The tunnel is a critical element in performing hypersonic aerodynamic and aerothermodynamic research.

5. Repair Potable Water Piping, West Area..... 370,000

This project provides for replacement of approximately 5,700 feet of existing cast iron water pipe. The existing pipe, which is 30 years old, has deteriorated to the degree that the water supply often does not conform to potable water standards set by the U.S. Public Health Service.

6. Replace 22 KV Electrical Feeder Cable, East Area..... 680,000

This project provides for the replacement of a 22 KV electrical feeder cable that runs from the West Area Stratton Road Substation (B-1233) to the East Area Back River Substation (B-642). The work to be accomplished under this project will include the installation of approximately 15,000 feet of direct buried cable, the installation of new 22 KV circuit breakers, and structural modifications in the substations to provide support for cable trays and circuit breakers. The existing installation is over 40 years old and is not reliable to ensure continued long-term dependable power supply to the East Area research facilities.

- H. Lewis Research Center (LeRC) \$2,850,000

1. Repair Process ~~Air~~..... 600,000

This project consists of the repair of pressure systems for recertification. It includes repair of deteriorated process air systems piping, supports, expansion joints, coolers, dehydrator and other related components. Normal wear/corrosion of piping and components in the process air systems has resulted in conditions which required repairs and/or replacement to ensure structural adequacy and continued safe operating conditions. The process air systems are critical to the successful accomplishment of research tasks at LeRC. This work is necessary to preserve system safety, integrity, and reliability.

2. Repair of Primary Cooler Heat Exchanger,
Propulsion Systems Laboratory (PSL)..... 700,000

This project will repair approximately the first two banks of tubing in the primary cooler heat exchanger of the Propulsion Systems Laboratory (PSL) Building 123. The work includes removal of approximately 720 tubes; fabrication of new tubing; field installation including welding, tube joint expansion and tube bundle support plates; and hydrostatic testing after completion of assembly and welding. The primary cooler

which is the critical component of the PSL facility reduces the temperature of engine exhaust gases before final discharge through exhaust machinery. This cooler has been in operation since 1972, and the first two banks of tubing have deteriorated because of extensive after-burning engine operation in the test cells, internal and external corrosion, and fatigue due to vibration. This first increment of testing must be repaired to maintain the facility in operational status and to reduce risk to the hypersonic engine program.

3. Repair Domestic Water Systems, Various Buildings 400,000

This project provides for the separation of domestic and process/nonpotable water distribution system of the LeRC Potable Water Distribution System, in Buildings 49, 83, 100, 104, 105, 107, 109, 110, 10x10 Complex, 500 and 501. This project is part of a planned program to upgrade the domestic water system and provide a protected potable water distribution system. This project will remove the possible hazard created by cross-connections between the two water systems and the possibility of backsiphoning.

4. Repair Grounding System, Various Buildings..... 300,000

This project will provide for repair of grounding grid systems at all LeRC electrical substations. Existing systems with ground resistance in excess of one (1) ohm (Substations A, B, G and K) or five (5) ohms (secondary substations) will be repaired by the addition and connection of grounding electrodes, new grounding grid and interconnecting cables. The substations must be provided with grounding grid systems of low system impedance to maintain voltage drops at tolerable levels and minimize hazardous potential differences for personnel safety and to dissipate surges due to lightning strokes.

5. Repair of Valves in Combustion Air System, Building (64)..... 400,000

This project provides for the replacement of several large diameter (30" to 48") isolation valves in the LeRC Combustion Air System at the Central Air Equipment Building (64). The existing 30-year-old isolation valves do not open and close properly and leak in spite of frequent maintenance. Replacement of the valves will alleviate these problems as well as improve system safety. Other benefits include increased system safety by minimizing leakage into areas that are to be depressurized and power consumption energy savings as a result of reduced valve leakage losses.

6. Repair of Roof, Building (14).... 450,000

This project provides for replacement of approximately 65,000 square feet of deteriorated roofing on the Technical Services Building (14). The work in this project includes removal of all roofing materials and penetrations; installation of a new 5-ply roofing system; and insulation to meet current ASHRAE Standards, installation of new roof penetrations. The roofs at the Technical Services Building (14) are in constant need

of maintenance and are not in compliance with current safety and ASHRAE standards. This project is necessary to provide proper protection for the building and its housed equipment.

I. Marshall Space Flight Center (MSFC).... \$2,290,000

1. Repair Pressure Vessels 700,000

This project provides for the repair of pressure vessel defects identified during safety survey of the pressure systems. Work includes inspection, repair, and testing of 23 gaseous nitrogen and high pressure air pressure vessels. These pressure vessels store a large volume of high-pressure gases that support the Space Shuttle test programs. It is essential that the structural integrity of these vessels be maintained. Loss of this storage capacity would impair all major test programs at MSFC.

2. Repair High-pressure Piping. 720,000

This project provides for the repair and replacement of old obsolete high-pressure piping systems. Work includes the replacement of 14,000 feet of helium and high-pressure air lines and related equipment. These high-pressure piping systems have deteriorated through age and heavy cyclic use in supporting major test programs at MSFC. This repair work will eliminate potential hazards due to corrosion and possible leakage that can occur to adjacent inhabited buildings.

3. Repair Roofs, Various Buildings 450,000

This project provides for repairing approximately 170,000 square feet of roofing for various buildings including Buildings 4200, 4485, 4667, 4746, and 8023. Work includes installation of new roof systems with insulation, flashing, expansion covers, control joints, gravel guards, and related work over existing roof decks. Also included will be elimination of unnecessary roof openings, replacement of vents and hatches, roof deck repairs, and recoating smooth-surfaced roofs to extend roof life. Spot repairs are no longer effective or economical. The roofs are weathered, dried out, and have soft spots where insulation is saturated. To alleviate these problems, and to preserve the structures, these roofs must be repaired.

4. Repair Exterior, Various Buildings... 420,000

This project provides for the exterior repair of approximately 680,000 square feet of building walls and surfaces of various buildings. Work includes surface preparation and application of protective coatings, repair or replacement of gutters, downspouts, windows, doors, and related work. Building 4728 will be repaired with a new exterior surface and insulation over the existing block walls. Exterior repair is required to protect these buildings from the cumulative damaging effects of deterioration and will preserve

these facilities for continued operation. Building 4728 is over 45 years old and is in critical need of repair. The installation of new exterior siding and insulation will reduce energy consumption, maintenance, and short-term repair efforts.

J. Michoud Assembly Facility (MAF)..... \$1,030,000

1. Repair HVAC System Building (102) 680,000

This project provides for the repair and replacement of HVAC systems in five rooftop fanhouses of Engineering Building, Building 102. Work includes the repair of the coils, motors, dampers, piping, ductwork, and related mechanical equipment in the HVAC systems. Building 102 is over 40 years old and the HVAC equipment is deteriorated, and uneconomical to maintain. Major repair of the HVAC system is necessary to provide an adequate working environment for employees.

2. Repair Roofs of Hazardous Storage, Cafeteria, and Equipment Buildings..... 350,000

This project provides for the repair of approximately 550,000 square feet of roofing on the Hazardous Storage Building (221) and the Cafeteria and Equipment Building (351). The repairs include the removal of the existing roofing and replacing it with a new roofing system including insulation, control joints, gravel guards and related work. These buildings are over 20 years old, the roofs leak, the insulation has deteriorated, and repair work is required now.

K. National Space Technology Laboratories (NSTL)..... \$2,220,000

1. Repair of Cathodic ~~Protection~~..... 430,000

This project provides for the replacement and repair of the cathodic protection system to the navigation lock, potable water towers and the sitewide buried high-pressure gas and utility systems as needed. NSTL has recently experienced several ruptured pipes and a recent survey indicated that approximately half of the anode beds are operating at less than 15-percent capacity and continuing to deteriorate. Work includes replacing the water tower's cathodic protection system, installing new anodes, connecting the anodes to existing rectifiers, and expanding the existing utility control system (USC) to monitor the operation of all the rectifiers.

2. Repair of Chiller Units, Building (1100) 520,000

This project provides for the replacement of two high-temperature hot water absorption chillers (300 tons each) in the Administration Building 1100, with two electrically driven centrifugal water chillers (165 tons each). Modifications also include the replacement of circulating pumps and the addition of electrical services to accommodate the electrically driven machinery. The absorption chillers have been in continuous use for more than 23 years and have significant repairs to maintain satisfactory operating condition. Replacement of the absorption units with electrically driven units will provide a more energy-efficient and cost-effective system.

3. Repair of Water Chilling System, Building (8100) 550,000

This project provides for the replacement of two high-temperature hot water absorption chillers (230 tons each) in Building 8100, instrumentation laboratory, with two electrically driven centrifugal water chillers (135 tons each). The existing absorption units have been in continuous use for over 20 years. Similar units have failed in the past 5 years because of age and deterioration. Replacement of these units now will preclude a major failure and provide the most energy-efficient operation at the lowest life-cycle cost while maintaining essential service to the instrumentation laboratory.

4. Repair of NSTL Primary Roads..... 720,000

This project provides for the repair of approximately 65,000 square yards of road paving. Repair work must be accomplished in this timeframe to preserve the road system from excessive surface deterioration and prevent extensive substructure breakdowns in the future. The roads to be repaired are road "B" (4 lanes) from road "L" south to road "J"; widen and repair road "J" east to road "E", road "E" south to lower Gainesville Road; and the lower Gainesville Road to its end at the Pearl River.

L. Wallops Flight Facility (WFF) .. \$1,570,000

1. Repair of Seawall at Launch Pad 2..... 600,000

This project provides for the repair of the Wallops Island seawall in front of Launch Area 2 to protect the launch pad and associated facilities. The construction will be in front of and over the existing seawall. The project will include all necessary excavation and fill. This work is necessary to prevent or minimize storm damage at Launch Area 2 which is becoming increasingly vulnerable due to beach erosion and deterioration of the existing protection system.

2. Repair of Building E-134.. 220,000

This project provides for the repair of the Mobile Radar Shop/Storage Building E-134. The work includes the replacement of 8,100 square feet of roof, the removal of existing and installation of new partitions and interior finishes to provide laboratory space, modification of toilet facilities, replacement of personnel and roll-up doors; exterior wall modifications, installation of new floor surface on the mezzanine; and installation of new mechanical, electrical, and fire protection systems in modified areas. This facility was built in 1955 and has had no major renovation work to date.

3. Repair of Aircraft Parking ~~Raps~~..... 450,000

This project provides for the repair and resurfacing of the aircraft ramp areas east of Aircraft Hanger, Building D-1, east of Air Traffic Control Operations, Building A-1, and northeast of Aircraft Fire and Crash, Building B-129. These primary ramp areas have deteriorated to the extent that broken pavement presents a Foreign Object Damage (FOD) hazard to aircraft and associated personnel.

4. Repair of Pressure Systems..... 300,000

The work includes (1) repairing 16 tank-mounted compressors (14 on the Island and 2 on the mainland) and installation of automatic drain valves, replacement of gauges and relief valves, and repair of the electrical systems. This work also includes replacing five noncoded tank-mounted air compressors and repairing/modifying the service air system for the Plant Operations and Maintenance Building, F-16; (2) repairing structural damage to the two Island air storage spheres; (3) repairing the aboveground Island air distribution system (4) repairing the LN₂ storage tank at Range Control and Evaluation Facility, Building N-159 to correct corrosion damage; (5) repairing the Advance Data Acquisition System's lubrication and hydraulic oil systems; (6) repairing the liquid oxygen storage tank at Liquid Oxygen Storage Facility, Building A-38; (7) repairing structural defects, replacing the cathodic protection system, and providing freeze protection for the Island's 45,000-gallon elevated water storage tank, X-45; and (8) repairing malfunctioning controls and instrumentation for water storage tank systems U-49, X-45, and V-90. This project is required to restore these pressurized systems to acceptable operating standards and ensure their continued performance in supporting the overall mission of Wallops.

M. <u>Various Locations.</u>	<u>\$210,000</u>
1. Repair of Water Supply Pump House, Goldstone, CA.....	210,000

This project provides for the replacement of two NASA-owned 145 gpm vertical turbine water supply pumps and drive motors at the Fort Irwin water pump house and replacement of two 750 gpm and one 1,000 gpm pumps and drive motors at the Goldstone Deep Space Communications Complex (GDSCC). Also included are new pump controls and associated testing. The water supply motors and pumps have been in continuous service for 20 years. This is essentially the end of their useful life, and they must be replaced to ensure reliable water supply necessary for support of NASA's deep space missions and reliable fire suppression system performance. These supply pumps provide the only source of water for critical operations at GDSCC.

<u>MISCELLANEOUS PROJECTS LESS THAN \$150,000 EACH</u>	<u>\$ 895,000</u>
Total	<u><u>\$25,000,000</u></u>

FUTURE CoF ESTIMATED FUNDING REQUIRED TO COMPLETE THIS PROJECT:

An estimated \$25,000,000 to \$30,000,000 per year will be required for the continuation of this essential repair program.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1988 ESTIMATES

SUMMARY

REHABILITATION AND MODIFICATION

<u>Summary of Project Amounts by Location:</u>	<u>Amount</u>	<u>Page No.</u>
Ames Research Center	1,345,000	CF 9-3
Dryden Flight Research Center	1.235. 000	CF 9-3
Goddard Space Flight Center	3.100. 000	CF 9-4
Jet Propulsion Laboratory	1.270. 000	CF 9-6
Johnson Space Center	3.040. 000	CF 9-6
Kennedy Space Center	3.820. 000	CF 9-8
Langley Research Center	3.000. 000	CF 9-10
Lewis Research Center	3.060. 000	CF 9-11
Marshall Space Flight Center	3.500. 000	CF 9-13
Michoud Assembly Facility	1.970. 000	CF 9-15
National Space Technology Laboratories	2.220. 000	CF 9-15
Wallops Flight Facility	1.610. 000	CF 9-16
Various Locations	1.145. 000	CF 9-18
Miscellaneous Projects Not Exceeding \$150.000 Each	<u>1.685. 000</u>	CF 9-19
Total	<u>32.000. 000</u>	

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1988 ESTIMATES

PROJECT TITLE:	Rehabilitation and Modification of Facilities, Not In Excess of \$750,000 Per Project		
INSTALLATION:	Various Locations		
		FY 1988 CoF ESTIMATE:	\$32,000,000
FY 1986: \$26,000,000		FY 1987: \$30,000,000	

COGNIZANT INSTALLATIONS/LOCATIONS OF PROJECT: Various Locations

COGNIZANT HEADQUARTERS OFFICE: Office of Management

SUMMARY PURPOSE AND SCOPE:

These resources will provide for the rehabilitation and modification of facilities at NASA field installations and Government-owned industrial plants supporting NASA activities. Included in this request are those facility rehabilitation and modification needs for FY 1988 that have been fully identified at the time of the submission of these estimates, and are estimated not to exceed \$750,000 per project. The purpose of this program may include some restoration of current functional capability but also includes enhancement of the condition of a facility so that it can more effectively accomplish its designated purpose or increase its functional capability.

PROJECT JUSTIFICATION:

Based on the initial investment costs, the NASA Capital Type Property totals approximately \$7.7 billion (September 30, 1986), of which the physical plant comprises some \$4.0 billion. A continuing program of rehabilitation and modification of these facilities is required to:

- a. Protect the capital investment in these facilities by minimizing the cumulative effects of wear and deterioration.
- b. Ensure that these facilities are continuously available and that they operate at peak efficiency.
- c. Improve the capabilities and usefulness of these facilities and thereby mitigate the effects of obsolescence.
- d. Provide a better and safer environment for all personnel.

This program includes only facility rehabilitation and modification work having an estimated cost not in excess of **\$750,000**. The work is of such a nature and magnitude that it cannot be accomplished by routine day-to-day facility maintenance or by related routine facility work efforts that are provided for in other than CoF estimates.

PROJECT DESCRIPTION:

Proposed rehabilitation and modification projects for FY 1988 totaling **\$32,000,000** are described under "PROJECT COST ESTIMATE." The total program of **\$32,000,000** has been distilled from requests of approximately **\$54,000,000** and represents only a modest request in relation to the backlog of this type of work. Based on relative urgency and expected return on investment, the projects which comprise this request are the highest priority requirements. Deferral of this mission-essential work would adversely impact the availability of critical facilities, program schedules, and energy conservation objectives. Only those projects estimated to cost less than **\$150,000** have not been individually described or identified by Center. The total cost of these miscellaneous projects is **\$1,685,000**.

During the course of the year, some rearrangement of priorities may be necessary. This may force a change in some of the items to be accomplished. Any such change will be accomplished within available resources. The following broad categories of work are described further in the "PROJECT COST ESTIMATE:"

a. Utility Systems.	8,505,000
b. Fire Detection/Protection Systems.....	450,000
c. General Purpose Buildings.	2,415,000
d. Technical Buildings/Structures..	20,630,000

e. Pavements and Drainage. -0-

PROJECT COST ESTIMATE:

A. Ames Research Center (ARC) \$1,345,000
 1. Rehabilitate the High-pressure Air Distribution System 600,000

The high-pressure air distribution system was installed over 25 years ago and serves all major Ames research facilities. During subsequent years, piecemeal additions were made resulting in a system that has no central monitoring and control station and no control and monitoring devices within individual using areas. This project will provide necessary piping, valves, and control and monitoring electronics to connect four major high-pressure air users to the central station. Valves and piping will be upgraded and new instrumentation and controls will be provided. This project is the third part of a multiyear program to modify the high-pressure air system and upgrade it to a safe and reliable operating system.

 2. Modify Outdoor Aeronautical Research Facility 745,000

This project modifies the high-pressure air system by increasing the supply pipe size to 4 inches, and installing new valves, filter, and heaters to supply heated 3000 psig air to the model support fixture. The present system does not meet the requirements necessary to support planned testing at this facility. Without these modifications increased testing loads would be placed on the 40 X 80 X 120-foot wind tunnel which would reduce the productivity of this significantly more expensive facility.

B. Dryden Flight Research Facility (DFRF) \$1,235,000
 1. Modify Chillers (4800) 300,000

This project provides for the modification of the chillers, and chilled water distribution system serving Building 4800. The existing absorption chillers are obsolete and very inefficient. New electrically driven centrifugal machines will be provided along with necessary piping, pumps, valves, controls, and electrical switchgear. Effective maintenance is no longer possible on the existing absorption system and without a complete modification of the system to support the growing building load demands, frequent failure and outage will occur.

 2. Modify Photographic and Graphic Arts Facility. 745,000

This project provides for the rehabilitation and modification of the Photo and Graphic Arts facility to upgrade piping, valves, and system components including a new chemical neutralization system for all

photographic wastes, and a new water recycling system. In addition, an existing patio area will be enclosed with a roof to provide approximately 8,750 square feet of additional laboratory space on two floors. Modifications required include interior walls, stairs, air-conditioning, plumbing, electrical, and structural bracing for the enclosure as well as for photographic and graphic arts equipment. Without these modifications, DRRF will not be able to support adequately the expanding photographic and graphic arts requirements associated with Shuttle landings and various flight test activities.

3. Rehabilitate Aircraft Test Range Technical Area (4800). 190,000

This project provides for the rehabilitation of the Aircraft Test Range (ATR) Technical Area. The rehabilitation of 1,950 square feet includes walls, floors, ceilings, HVAC, and restrooms. The ATR technical area has been heavily utilized since 1953 with only minor maintenance being performed. The area is now in need of major rehabilitation to prevent further deterioration and bring the area up to acceptable occupancy standards.

C. Goddard Space Flight Center (GSFC) \$3,100,000

1. Modify Buildings 10/15 for Space ~~Station~~..... 730,000

This project modifies the second floor of the Launch Support Simulator Building 15 and the high bay area of the Environmental Test Laboratory, Building 10. The work in Building 15 includes the installation of 2,000 square feet of raised floor and utility systems modifications to accommodate technical support functions. In addition, there will be work in the high bay area of Building 10 for a 35ftx35ftx90ft work station for flight hardware servicing and assembly operations. This project is required to provide a Space Station ground simulator/model of the servicing bay and equipment for payload evaluation and development of servicing/assembly scenarios. The facility will be used to (1) develop sequences and procedures of servicing and assembly for payloads; (2) develop and evaluate use of robotics for assembly and servicing; (3) develop and evaluate the design of service equipment for the mechanical positioning, robotics, and electrical systems; and (4) develop and evaluate test verification methods for servicing payloads.

2. Modify Payload Test Facility and Environmental Test Lab..... 720,000

This project provides for modifying 46,000 square feet of concrete flooring slabs (24,000 square feet in the Payload Testing Facility, and 22,000 square feet in the Environmental Testing Laboratory) to increase their load-carrying capacity from 100 to 250 pounds per square foot. The work includes installing steel rods in the concrete slabs to increase the shear strength. In addition, general modification for handicapped accessibility is also included. This work is required to increase the load-carrying capacity of the floor so that it can safely carry the heavy payloads that are transported within these facilities. Currently, loads must be spread over a large area to avoid exceeding the current design load of 100 pounds per square foot.

3. Modify Launch Phase Simulator (15) 580,000

This project provides for modification of the Launch Phase Simulator in Building 15 to upgrade its capacity to test large payloads. The work includes the installation of an on-hand 5-ton bridge crane, and removal and replacement of the existing outmoded test chamber and associated vacuum and acoustic systems, and corresponding instrumentation and control systems. Also included are modifications of the centrifuge rotating structure and installation of a new payload testing platform, associated instrumentation and servicing systems. This work will provide for acceleration testing of Shuttle pallet size payload structures. Present utilization of the existing chamber is less than 10 percent because it is too small for large payloads. Refurbishment of the controls will advance the reliability of the facility. Modernization must be completed now to satisfy acceleration qualification of large structures scheduled for integration in 1990.

4. Modify Acid Polishing Facility, (5) 390,000

This project will modify 1,000 square feet of space on the north side of Building 5 to handle the acid materials. The work will include a ceiling system, lighting, mechanical/electrical services, and handling equipment. Recent technology has shown that glass and glass-type materials used for space flight optics should be relieved of all subsurface mechanical strain induced during fabrication. By submerging the optical components in a solution of sulphuric and hydrofluoric acid, the induced mechanical strain can be relieved but the process must take place in an area suitable to handle acids in a liquid and vapor form. No existing facility will satisfy the OSHA safety requirements for this process and a new area must be provided. In addition, the modified facility can be used for the stripping and cleaning of large mirrors to enhance reflectance requirements.

5. Modify Optical Instrument Clean Room (7) 680,000

This project provides for the conversion of Room 004 into a class 100 clean room for an optical instrument laboratory, Room 008B into a class 10,000 clean room, and Room 005 to a darkroom, in Building 7. Complete service facilities including HEPA filters, liquid and gaseous nitrogen, and temperature and humidity controls will be provided. Work on the Cosmic Background Explorer (COBE) program has demonstrated the need for class 100 assembly facilities for optical instruments. Current requirements are being met with temporary down flow clean tents. This is causing delays and a great deal of additional work in trying to meet the class 100 standards on the COBE programs. Future programs involving advanced infrared, optical, and ultra violet instruments will have similar or more stringent requirements, that cannot be met with temporary facilities. No other facilities exist at the GSFC to meet these requirements.

D. Jet Propulsion Laboratory (JPL)..... \$1,270,000

1. Modification of Acoustic Test Facility 144..... 390,000

This project will provide for the installation of two additional acoustic horns on the south side of the acoustic chamber in the Acoustic Test Facility, Building 144. Each horn will be equipped with an acoustical modulator and supporting peripherals. One horn will be 160 Hz (10 feet long) and the other horn (30 feet long) will be sized in the 20-40 Hz boost range. Also included will be revisions to the nitrogen pipe manifold which provides all pneumatic power to the horn transducers. This project is necessary to correct deficiencies in the acoustic simulation of Shuttle launches. The existing facility cannot adequately produce certain low and high frequencies present during Shuttle launches. Many of the instruments and spacecraft systems developed by JPL will be flown on the Shuttle and must be tested during the development process for acoustical sensitivity.

2. Modify Secondary Power System (180 and 183)..... 560,000

This project will provide modifications to the secondary power distribution system in the Administration Building (180) and the Physical Sciences Laboratory (183), to increase the number of isolated and dedicated circuits. The secondary electrical distribution panels in these buildings are filled to capacity. More dedicated circuits for computers, data processing equipment and lab equipment are required to improve the quality of electrical service to these sensitive and critical machines.

3. Modify Thermoelectric Laboratories, (277)..... 320,000

This project modifies 6,480 square feet of the Isotope Thermoelectric System Applications Laboratory, Building 277. The existing wet chemistry laboratory's hood exhausts, piping, and benches will be modified for electrochemical research. Existing ventilation systems will be rerouted and air monitoring devices installed. Necessary services for utilities such as argon, nitrogen, air, and natural gas will be provided. Increased activity in lithium battery research and testing requires controlled environmental conditions and safer handling procedures. As the lead Center, JPL needs to consolidate electrochemical power and some of the power electronics activities into a suitable laboratory environment. Between 25 and 30 laboratory personnel will be relocated into this building.

E. Johnson Space Center (JSC)..... \$3,040,000

1. Modify Shuttle Mission Simulator Complex (5)..... 710,000

This project provides for the upgrading of the Shuttle Mission Simulator (SMS) Complex in Building 5 to accommodate the replacement of computer and simulator hardware systems. Work includes the construction of

a second floor in Room 1007, installing computer flooring on the first floor and second floor in Room 1007, and providing associated air-conditioning and electrical power. The existing mission computers and simulator equipment are old, obsolete, and becoming increasingly unreliable. The equipment is being replaced under a multiyear plan.

2. Modify Mission Control ~~Ctr.~~..... 690,000

This project is the first increment of a multiyear program to support a major Mission Control Center (MCC) equipment replacement and upgrade. The existing console, display, and communications systems are to be replaced with integrated work stations and a digital voice intercom system in a progressive overlapping manner to avoid impact to ongoing Shuttle mission support. The character and magnitude of the equipment additions, changes, and relocations requires the installation of five 1,200-ampere distribution panels, modifications to the electrical distribution system, modifications to the existing air-conditioning system, and related architectural modifications.

3. Modify Life Sciences Development Facility (36)..... 700,000

This project provides for the modification of an existing clean room and adjacent support area in Building 36 to support life sciences experiment development and assembly. The facility will also be used to accommodate a high-fidelity test bed unit of the Space Station life science module for the verification of outfitting/experiment interfaces and conducting life science research. Work in the clean room includes installing approximately 5,000 square feet of raised flooring, a 10-ton monorail crane, and a fire detection system. Approximately 800 square feet of raised flooring and partitions will be installed in the support area.

4. Modify Advanced Avionics Systems Development (16) 720,000

This project modifies Room 1024 in Building 16 to support advanced avionics systems development primarily for Space Station applications. A 1,600-square-foot mezzanine will be constructed to accommodate installation of the partial mockups, scene optics, interface equipment, and central processing units for a manned-maneuvering unit (MMU) work station and a mobile servicing center system (MSCS) work station. Computer flooring, work station partitions, electrical power and grounding systems, cableways, supplemental air-conditioning, and fire suppression and fire-alarm equipment are included in this project. Minor wall modifications and partitioning in areas adjacent to Room 1024 will also be provided to support related equipment reconfiguration in the building.

5. Installation of Advanced Fire Detection System (30)..... 220,000

This project is necessary to provide a state-of-the-art fire detection system in the Mission Control Center (MCC). The under-floor areas of the MCC contain numerous power and communications cables and have large quantities of cooling air flowing to the floor-mounted electronic consoles and computing equipment. Because of unusually high airflows, conventional sensors do not provide the sensitivity necessary to detect early stages of fire or smoke. The new detection system will consist of pumps located under the floor which will automatically draw air samples into small chambers for high-sensitivity smoke particle detection.

F. Kennedy Space Center (KSC) \$3,820,000

1. Modify Crane in Cargo Hazardous Servicing Facility (CHS)..... 640,000

This project provides for an additional 50-ton overhead traveling bridge crane in the service bay of the CHSF to increase versatility and permit more efficient handling of large payloads. For example, the Upper Atmospheric Research Satellite is expected to be launched in Calendar Year 1989 and this facility will need two 50-ton cranes to lift the spacecraft into the payload canister.

2. Rehabilitate Utility Annex Master Control Console..... 450,000

This project will rehabilitate instrumentation, control components, wiring, panels, and support systems of the HVAC master control console of the Utility Annex. The entire system is antiquated and largely incompatible with other major control systems for chillers and boilers making the system difficult to maintain. A major control system failure at the Utility Annex would adversely affect STS launch operations.

3. Modify Communications Distribution and Switching Center
(CD&SC) Air-conditioning System..... 700,000

This project will modify the 20-year-old CD&SC air-conditioning system to correct fluctuating temperature and humidity conditions by replacing existing components with three 85-ton chillers, eight air-handler units, electric strip heaters, and new ductwork. Minor ceiling and wall modifications will be made to reduce room volume and cooling loads, and a small mechanical room will be added. Existing communications equipment requires stable temperature and humidity control, or equipment shutdown and possible equipment failure can occur. For example, loss of the GTE No. 2 telephone switch, housed in this building, would cause 75 percent of KSC to lose communications.

4. Modify Hangar L for Life Support Systems Laboratory.. 680,000

This project provides for modifications to Hangar L at CCAFS to accommodate a Controlled Environmental Life Support System (CELSS), and minor modifications to adjacent Hangar "Little L" to provide supporting storage space. The Hangar L modifications will provide approximately 1,200 square feet for CELSS work area; 1,200 square feet for general purpose laboratory area; 400 square feet for experiment staging areas; 400 square feet for a plant growth chamber area; and 1,200 square feet of support areas. These modifications are needed to support the recently assigned CELSS project, and will provide offices and work areas for resident scientists during long duration (3-6 months) experimentation for CELSS and Life Sciences Flight Experiment Programs.

5. Modify the Mainline Railroad System.. 700,000

This project will replace approximately 2.3 miles of existing 100-pound track with 132-pound track and welding the rail joints to form a continuous rail member. The replacement and welding would be done on track between the VAB and Wilson Junction. The KSC mainline rail system was designed for 110 gross-ton rail cars and is structurally marginal for carrying the Space Shuttle Solid Rocket Booster segment rail cars, which weigh 250 tons. Welding the rail joints will increase the rail strength at the joints and decrease rail wear and maintenance requirements.

6. Modify Central Instrumentation Facility (CIF)
Cooling Tower System..... 320,000

This project provides for the removal of Cooling Tower #1 at the CIF and replacement with a masonry-type cooling tower. The project also provides a modified concrete basin, three new condenser water pumps, controls, and piping. The 22-year-old wood structure type cooling tower has deteriorated and is inefficient. Replacement of this tower with a new energy-efficient cooling tower is critical to reliable support of computer operations, laboratories, and payload-tracking activities served by this facility.

7. Modify 15 kV Powerline From Pole N-1 to Pole N-81.... 330,000

This project provides for the replacement of 12,300 linear feet of overhead 15 kV powerline from Pole N-1 to Pole N-81 (Playalinda) with underground cable alongside State Road 402. The powerline is over 20 years old and requires a high level of maintenance. Replacement with underground cable will reduce maintenance costs and ensure sufficient reliability for uninterrupted service to the various camera sites supporting STS launches.

C. <u>Langley Research Center (LaRC)</u>	<u>\$3,000,000</u>
1. Rehabilitation of HVAC Computer Complex, (1268)	700,000

This project provides for the rehabilitation of the heating, ventilating, and air-conditioning systems serving LaRC's scientific computer complex. The work includes the installation of free-standing air-handling units and modifications to the utility systems to provide services to the new air handlers serving computer areas on the second floor of Building 1268. Five existing chillers and associated chilled water pumps will be manifolded to provide load matching and redundancy. This project continues major modifications necessary to update and modernize the utilities serving the computer complex to provide better reliability and flexibility.

2. Modifications to the Hypersonic Helium Tunnel.....	490,000
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This project provides for modifications to the Hypersonic Helium Tunnel (1247B). The work to be accomplished includes the fabrication and installation of a new model injection/support system that will have the capability of being rapidly injected into and retracted from the tunnel flow and to provide for angles-of-attack from -15° to 50° and angles of sideslip between $\pm 5^{\circ}$. The modifications are necessary to improve the capability of the existing tunnel to support rapidly expanding needs in support of hypersonic research especially for easy screening of candidate configurations for advanced hypersonic vehicles such as the aerospace plane.

3. Modify Avionics Integration Research Laboratory (1220).	500,000
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This project provides for enclosure and modification of approximately 7,600 square feet of existing second floor area in the Avionics Integration Research Laboratory, Building 1220. The work to be accomplished will include installation of gypsum board perimeter and partition walls; raised computer floor; suspended ceiling with recessed light fixtures; modifications to the heating, ventilating, and air-conditioning system; and the installation of restroom facilities. The modifications are required to create additional laboratories to support expanding avionics research and integration testing in support of NASA and DOD programs specifically related to software development for aerospace vehicles flight guidance and control systems.

4. Rehabilitate Power Control System for MACH 6 & 8 Heaters (1247D)	680,000
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This project provides for the fabrication and installation of a new power control system to regulate the MACH 6 and MACH 8 2300-volt, 13-megawatt heaters in Facility 1247D. The new heat control system will be controlled by a new microprocessor-based automated system. The existing system is 20 years old and designed for manual control. The new system is required to provide more accurate temperature control and to improve the efficiency of the facilities that use the heaters.

5. Rehabilitation of the High-Temperature Materials Laboratory (1267) .. 630,000

This project rehabilitates approximately 8,500 square feet of existing office and laboratory area in Building 1267. The work includes the installation of energy-efficient windows and lights, roof replacement, upgrading the HVAC system, enlarging and upgrading restrooms to provide for handicap access, and the construction of a 2,100-square-foot addition to the west end of the facility. The modifications are required to upgrade the existing facility and to provide needed additional space to support high-temperature materials research associated with high-speed aircraft and space vehicles.

H. Lewis Research Center (LeRC) \$3,060,000

1. Modify Instrument and Control Areas in
Rocket Engine Test Facility (202) 690,000

This project provides for modifications to the instrument, control, and power termination areas at the Rocket Engine Test Facility, Building 202. The work includes enlargement and upgrading of the instrument and controls termination areas, upgrading and modification of the electrical distribution system, and the intercommunications system. The instrument, control, and power termination areas for the Rocket Engine Test Facility were originally designed to support one test stand. Because of expansion of the Facility, additional stands will become operational during FY 1986. The work in this project is critically needed to support the research control and instrument system and improve productivity in this multistand test facility.

2. Modify Laboratory in Communications Laboratory Building (55) .. 690,000

This project provides for the rehabilitation of the laboratories and support areas in the Communications Laboratory Building 55. The work in this project includes replacement and upgrade of the HVAC System; rehabilitation and upgrade of the lighting and electrical systems; replacement of doors and windows; rehabilitation of walls and ceilings; and other architectural work. The project also includes an advanced communications experimental ground station at an offsite location. This program will develop the next generation of communication technology to maintain the U.S. preeminence in space communication. The work in this project is necessary to provide the proper laboratory environment both onsite and offsite for this vital communications research. The support areas are needed to improve mission performance by providing space for data analysis, contract training and reviews, experiments planning, observation of control center, and conferences.

3. Rehabilitate Composites Testing Laboratory (51) .. 690,000

This project provides for the rehabilitation of the High Energy Fuels Laboratory (HEFL) Building 51 in order to upgrade the composite materials testing laboratory to support hypersonic program requirements. Work

includes rehabilitation of exterior building shell, installation of new roof, new overhead and personnel doors, tuckpointing and repair of masonry wall, concrete coating, and painting and reglazing of exterior windows. Mechanical work includes replacing steam condensate return and air-conditioning units. Electrical work includes installation and distribution of new 480V AC power, and replacement of various power/lighting panels, receptacles, switches, lighting fixtures, and motor starters. Hypersonic application requires a materials fabrication and structural testing capability that is not currently available at the Center. This project will improve the conditions of the existing building and provide an environment suitable for hypersonic testing.

4. Modify Instrument/Control
Systems of the Central Air System (5 and 64). 390,000

This project will modify the instrumentation and control equipment of the central air system in the Engine Research Building 5 and the Central Air Equipment Building 64. The work consists of replacing existing pressure devices and adding pressure, temperature, flow, vibration, and instrumentation to monitor rotating equipment in the process air systems located in Building 5 and Building 64. In addition, pressure and limit switches shall be provided to monitor Cooling Towers Nos. 1, 3, 4, and 6 to prevent freeze damage. Associated modifications to the central control building systems will also be made. Upgrading the Instrumentation of the Central Air System is planned to improve the monitoring and control capability of the system. This upgrade will provide for earlier warning of impending problems to critical cooling tower and compressors units and will improve the safety aspects of operation of the large facilities.

5. Modify Propulsion Systems Laboratory (PSL)..... 600,000

This project provides for the modifications of the fuel supply storage tanks system for the PSL altitude test facility. The work includes deactivation and removal of the four existing aboveground fuel storage tanks in Building 48, capping off underground piping distribution system to Building 125; and the removal of the aboveground carbon steel fuel piping at Building 125. Fuel storage for JP-4 and Jet A-1 will be provided by two (2) 25,000-gallon underground fiberglass tanks onsite at Building 125. All piping, pumps, filters and valving for the fuel distribution system will be stainless steel. The aged fuel storage and distribution system is constructed of carbon steel, is corroded, and is a major source of fuel contamination for research engine testing. The new underground fuel storage system will provide noncorrosive storage with the required dual-fuel capability. The stainless steel distribution system will eliminate test fuel control contamination, increase fuel storage system integrity, and increase system reliability. This will eliminate a potential fire hazard to the PSL Cooling Towers (3 and 6).

I. Marshall Space Flight Center (MSC)..... \$3,500,000

1. Modify Environmental Test Facility (4619)..... 720,000

This project modifies the Environmental Test Facility in Building 4619. Work includes the relocation of 14 environmental and thermal vacuum chambers from Building 4476 to the west end of Building 4619. Included are the foundations for the chambers, utility services, controls, connections to the liquid nitrogen system, and related equipment. Consolidating the environmental test operations in Building 4619 results in more effective use of manpower and cryogenic storage and distribution system for liquid nitrogen with total savings of approximately \$150,000 a year. The present location in Building 4476 is extremely congested causing difficult operating conditions and a risk of damaging large flight hardware test articles during handling.

2. Modification for Nondestructive Test Facility (4702) 490,000

This project provides for modifications to Building 4702 for office space and laboratory facilities to support nondestructive inspection and test operations. Work includes partitions, ceilings, light fixtures, restroom, air-conditioning, electrical power, and mechanical modifications. The nondestructive test facility is being relocated from Building 4605 to Building 4702 to consolidate and improve test operations in support of the Space Shuttle and Space Station programs.

3. Modify Engine Flow Facility (4733)..... 425,000

This project provides for the modification of 1,500 square feet of space in Building 4733 for an engine flow facility. The modifications will include two closed-loop pressurized systems with a supply tank, pump, associated mechanical equipment, and an instrumentation room. Work also includes air-conditioning and ventilation. This facility will permit laser measurements of flow velocities in transparent models of stationary or rotating engine components in support of rocket engine development programs.

4. Modifications to Robotic Laboratory (4619)..... 700,000

This project provides for modifications of 4,000 square feet of the Robotics Laboratory, Building 4619, for a staging area for Space Station payloads. Work includes the dismantling and removal of the Skylab display. Modifications will include a concrete raised floor pad with an epoxy surface, tent enclosure, HVAC with dust control, lighting, and electrical power. These modifications are needed to provide for assembly and checkout of test articles for docking studies in support of the Space Station.

5. Modify Hardware Simulation Laboratory (4476) 440,000

This project provides for modification of 3,700 square feet in the Hardware Stimulation Laboratory, Building 4476, for a rocket engine Technology Test Bed, (TTB). Modifications include partitions, raised floor system, lighting, HVAC electrical power systems, and related mechanical equipment. The laboratory will perform computer software verification and validation and provide real-time support of software programs for the rocket engine hot-fire test required by the TTB project.

6. Modify Clean Room (4656) 185,000

This project provides for modifications to the clean room in Building 4656 to support development of controls for the Space Station. Modifications include an addition of 528 square feet, airlock, air-conditioning, filtering, and related mechanical equipment to upgrade the clean room. The clean room is inadequate and too small for the development and failure analysis of electromechanical control equipment for the Space Station. Without the modifications and upgrading of this facility, the clean room will not be capable of supporting necessary Space Station control development activities.

7. Modify Building Systems Management. 350,000

This project provides for the modifications to the computer-based Utility Control System by adding 14 buildings to the systems. Modifications include the installation of controls for the air-conditioning system to start and stop air-handlers and related equipment for more effective use of electrical energy. These modifications will complete the planned Utility Control System which will result in a reduction of operating costs.

8. Modifications to Materials and Processes Laboratory. 190,000

Project provides for the modifications to the Payload Crew Training Complex (PCTC) in Building 4612 with the installation of a 90-kW uninterruptible power supply (UPS). The UPS will consist of a battery pack with supporting switching equipment and utilities that can provide emergency power to the computers for approximately 15 minutes. An addition will also be provided to house the electrical equipment. The four computer systems in the PCTC, with associated equipment, provide flight crew training and joint integrated simulation support for ~~MSFC~~ payload missions. An uninterruptible power supply will eliminate electrical surges and disturbances that cause loss of data that could impose loss of support during critical functions.

J. Michoud Assembly Facility (MAF) \$1,970,000

1. Rehabilitate Chemical ~~Tis~~..... 650,000

This project provides for the rehabilitation of five 16,000-gallon chemical solution tanks to eliminate potential chemical spills. Work includes the relining of the tanks, replacing pumps, valves, and associated mechanical systems. The chemical tanks support the washing of the Space Shuttle external tank. The system is old, deteriorated, and the rehabilitation work is necessary to minimize potential operational shutdowns.

2. Rehabilitate East Master ~~Station~~..... 720,000

This project provides for the rehabilitation of the East Master Substation by the replacement of the 13.8 kV electric power switchgear units in the substation control shelter. Work also includes the replacement of ground system, and installation of overhead lightning protection equipment and smoke detectors. The East Master Substation is the primary source of electrical power for the production facilities in Building 103 of MAF. The switchgear and related equipment is over 33 years old, deteriorated, and spare parts are difficult to obtain. Rehabilitation of the substation will minimize potential production disruptions or shutdowns because of the failure of critical substation equipment.

3. Rehabilitate and Modify Substations 11, 13, and 16..... 600,000

This project provides for the rehabilitation and modification of three production-essential electrical power substations at MAF. Work includes the installation of a 2,000KVA transformer and related equipment at Substation 11, and replacing two 1500KVA transformers at Substation 13. The electrical power switchgear will be replaced at Substation 16. These modifications are required to replace 30-year-old inadequate electrical power equipment serving essential production support operations at MAF to improve the reliability of the electrical power system.

K. National Space Technology Laboratories (NSTL) \$2,220,000

1. Modify High-pressure Gas Storage Vessels..... 720,000

This project provides for the installation of one 600 CF gaseous hydrogen (GH) vessel in the SSME test complex. Of the three gaseous hydrogen storage vessels originally installed in the test complex, only one is currently in operation. The other two were put out of service after they failed the pressure vessel certification tests. The remaining vessel meets present test requirements, but has no backup in the event of a failure. In addition, the maximum allowable working pressure for the remaining vessel has been reduced from

6,000 to 3,000 psi because of hydrogen embrittlement and stress corrosion. The new vessel will provide needed backup to the existing vessel to preclude engine test delays.

2. Modify High-pressure Gaseous Hydrogen Distribution System. 700,000

This project provides for the replacement of the gaseous hydrogen (GH) distribution system in the Space Shuttle main engine (SSME) "A" test complex. Replacement of this piping is necessary to eliminate the potential for pipe fracture which would cause a serious delay in the SSME test program. The existing piping is made of T-1 steel, is 20 years old, and has been identified as susceptible to hydrogen embrittlement, stress corrosion, and cracking. Approximately 4,000 liner feet of T-1 steel pipe will be replaced with 2 1/2-inch diameter 304L, stainless steel piping. Road crossing, barricades, and cross-country pipe protection will also be provided.

3. Modify High-Temperature Hot Water Generating System... 300,000

This project provides for the installation of natural gas-fired hot water generators in the data acquisition facility, Building 4995, and the high-pressure industrial water emergency power and heat plant, Building 4400. This project removes these buildings from the central high-temperature hot water (HTHW) distribution system to improve operating efficiency. The replacement of absorption chillers with electrically driven machinery has reduced energy demand on the HTHW generators so that they operate at a low and inefficient firing rate. This project will permit the shutdown of this inefficient HTHW distribution by providing a stand-alone system for these facilities.

4. Modifications to Potable Water System..... 500,000

This project provides for the replacement of pumps and chlorinators at Wells 1 and 2, installation of approximately 15,000 linear feet of new water mains including appurtenances, and expansion of the utility control system (UCS) to control/monitoring of the potable water system operation. The new water mains will provide a looping (alternate path) in critical areas to ensure that water is available for personnel and at sufficient pressure to fight a fire in the event of a line break. The potable water system is 20 years old and has deteriorated in several locations.

- L. Wallops Flight Facility (WFF)..... \$1,610,000

1. Rehabilitation of Fire Protection System..... 400,000

This project provides for the rehabilitation of the fire protection systems on the Main Base and Wallops Island. The work includes the installation of alarms and sprinklers, replacement of existing alarm connecting lines, and installation of a monitoring system for Island Damage Control. Specific facilities

included in this rehabilitation are Aircraft Hangar, Building D-1, Records Storage Building E-7, Dormitories F-4 and F-5, Administration Building F-6, Damage Control Building X-35, Special Projects Building X-85, and Radar Control Building Y-60. The present fire protection system is marginal and does not work properly. Many hazardous areas at present have no alarm or sprinkler systems. The Wallops Island communications line is deteriorated and nonfunctional. This protection is essential to ensure the safety of personnel and equipment.

2. Modification of Telemetry Receiving Facility, (N-162) 400,000

This project provides for the modification of 4,800 square feet of laboratory space within the storage area in the high bay of Building N-162. The laboratory space will be a continuation of the second floor of the building and will incorporate structural, mechanical, and electrical modifications to the existing systems. This space will house telemetry and communications equipment needed for the ADAS 60-foot antenna system, satellite communications, and the orbital tracking network. The building houses telemetry, timing intercommunication, radio receiving, frequency monitoring, TV range control, and meteorological systems at Wallops Flight Facility.

3. Rehabilitate and Modify Water Distribution System.. 350,000

This project provides for the rehabilitation and modification of the water distribution system at Wallops Island. The work includes the installation of two new wells, a minimum of 220 feet in depth each, in the U area to supplement launch facility fire prevention and potable water supplies, and the installation of a 6" x 12,000' "loop" to the existing water main from W-52 to V-65 to prevent "dead ends" and stagnation of water supplies on the north end of the Island. Currently, there are only two shallow wells serving the Island and mainland complex. The new wells and piping are required to supplement and enhance the reliability of the existing potable water and fire protection systems.

4. Modify Runway Lighting Systems.. 260,000

This project provides for the modification of the existing lighting systems by extending the runway edge lighting (REL) to Runway 17-35. This runway is the primary runway for the Goddard Space Flight Center/Wallops Flight Facility Airport. REL for runway 17-35 would permit night landings on this runway at lower instrument minimums, thus precluding potentially hazardous night circling approaches.

5. Rehabilitate Reproduction Facility (F-1)..... 200,000

This project provides for the rehabilitation of the Reproduction Facility Building F-1. The work includes the installation of fire protection systems; the replacement of floor tile and ceiling tile; the installation of insulation in exterior walls and ceiling, thermal windows, metal exterior doors, and new wallboard for exterior walls; the installation of soffit and fascia covering; repairing cracks in mortar

joints in exterior walls; and installation of a heating, ventilation, air-conditioning system (HVAC). The building, built in the mid-1940s needs rehabilitation to improve energy efficiency, and for replacement of deteriorated doors, windows, and soffits. A new HVAC system is necessary to replace antiquated steam-supplied heating and window unit air-conditioners. The replacement of broken floor tile and ceiling panels, and the installation of sound absorbing materials in F-1 will improve safety and working conditions.

M. Various Initiatives..... \$1,145,000

1. Modify Fire Water Distribution System, Goldstone, CA..... 230,000

This project provides for installation of a backup diesel-engine-driven fire pump and modifications to the fire pump house and fire water distribution system at both the DSS-12 and the DSS-13 sites at the Goldstone Deep Space Communication Complex (GDSCC). Work at DSS-12 will include a new 335-square-foot structure to house a new 1,000 gpm pump with associated piping and valves. The DSS-13 work also will include a 335-square-foot structure, a 750 gpm pump and associated piping and valves. Protection of personnel and equipment in case of fire and simultaneous loss of electrical power is mandatory. These backup pumps will provide this capability which is essential for ensuring safe and reliable support for NASA's deep space missions.

2. Modify 70-Meter Antenna Access Elevator, Madrid, Spain..... 500,000

This project provides for the construction of two 1,000-pound-capacity personnel/freight elevators including extension of existing platforms on the 70-meter antenna at Madrid, Spain. One elevator will be located next to the stairwell structure, and will extend from ground level up to the 75-foot level of the alidade building. The other elevator will extend from the elevation drive platform (65-foot level) up to the elevation-bearing platform (105-foot level). The modification, maintenance, and installation of mechanical and electronics components on the antenna has increased personnel activity on the antenna. Personnel are required to carry tools, test equipment, and components up ladders and steep stairways on the equivalent of a 10-story building. Installation of the elevators will improve personnel productivity, reduce antenna downtime, and reduce the risk of injury to personnel and damage to equipment.

3. Modify Buildings for Seismic Safety, Goldstone, CA..... 415,000

This project provides for the structural modifications of the Cafeteria Building (G-21) at Deep Space Station (DSS) 12 and the Transmitter Building (G-53) at DSS 13. These modifications will correct structural deficiencies, and will strengthen the buildings against possible seismic events, in accordance with the Uniform Building Code for Seismic Risk Zone 4. This code requires that complex buildings be modified to meet seismic safety criteria.

MISCELLANEOUS PROJECTS LESS THAN \$150,000 AE	\$ 1,685,000
<u>TOTAL</u>	<u>\$32,000,000</u>

FUTURE CoF ESTIMATED FUNDING REQUIRED TO COMPLETE THIS PROJECT:

An estimated \$32,000,000 to \$37,000,000 per year will be required for continuing rehabilitation and modification needs.

MINOR CONSTRUCTION

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1988 ESTIMATES

SUMMARY

MINOR CONSTRUCTION

Summary of Project Amounts by Location:

	<u>Amount</u>	<u>Page No.</u>
Dryden Flight Research Facility	490.000	CF 10-2
Goddard Space Flight Center	980.000	CF 10-3
Jet Propulsion Laboratory	910,000	CF 10-3
Johnson Space Center	400.000	CF 10-4
Kennedy Space Center	1.270.000	CF 10-4
Langley Research Center	940,000	CF 10-5
Lewis Research Center	480.000	CF 10-6
Marshall Space Flight Center	200.000	CF 10-6
Michoud Assembly Facility	180.000	CF 10-6
National Space Technology Laboratories	820.000	CF 10-7
Wallops Flight Facility	550.000	CF 10-7
Various Locations	<u>780.000</u>	CF 10-8
Total	<u>8.000.000</u>	

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1988 ESTIMATES

PROJECT TITLE:	<u>Minor Construction of New Facilities and Additions to Existing Facilities, Not in Excess of \$500,000 Per Project</u>	
INSTALLATION:	<u>Various Locations</u>	
	FY 1988 CoF ESTIMATE:	<u>\$8,000,000</u>
	FY 1986: \$6,000,000	FY 1987: \$7,000,000

COGNIZANT INSTALLATIONS/LOCATIONS OF PROJECT: Various Locations

COGNIZANT HEADQUARTERS OFFICE: Office of Management

SUMMARY PURPOSE AND SCOPE:

These resources will provide for minor facility construction at NASA field installations and Government-owned industrial plants supporting NASA activities. Each project included in this program is estimated to cost not more than \$500,000 and involves either the construction of new facilities or additions to facilities. The FY 1988 request of \$8,000,000 will improve the usefulness of NASA's physical plant by changing the utilization of or augmenting the capabilities of various facilities. Included in this request are those programmatic and institutional projects that are essential to the accomplishment of mission objectives.

PROJECT JUSTIFICATION:

The configuration of NASA's physical plant necessarily must respond to changes in utilization and adaptations required by changes in technology or in mission needs. Demands are generated by research, development, test, and similar activities. Specific justification for each minor construction project is provided under "PROJECT COST ESTIMATE."

PROJECT DESCRIPTION:

Included in the FY 1988 minor construction program are those facility projects for institutional or technical facility needs which could be fully identified at the time of submission of this budget estimate. Items of work totalling \$8,000,000 are included in this resource request and have been distilled from a list totalling over \$17,000,000. Projects were selected on the basis of the relative urgency of each item and the expected return on the investment. During the course of the year, rearrangement of priorities may require changes in some of the items to be accomplished. Such changes will be accommodated within the resources allocated.

These projects represent requirements that must be met in this time frame to support institutional needs and programmatic objectives. The following listing summarizes the cost distribution by category of work:

a. General Purpose Buildings	4,800,000
b. Technical Buildings/Structures.....	2,750,000
c. Buildings	450,000

PROJECT COST ESTIMATE:

A. <u>Dryden Flight Research Facility (DFRF)</u>	<u>\$490,000</u>
1. Construction of Addition to Building 4820.....	490,000

This project provides for the addition of 3,800 square feet of high bay to the Flight Loads Research Facility (4820). The building addition will complement the existing structure and will include necessary power, lighting, plumbing, and HVAC. Two separate laboratories will be constructed to support flow visualization, and load frame/hydraulic studies. These laboratories now share common high bay space but need to be separated. This will improve safety and security of operation, as well as efficiency and productivity.

B. <u>Goddard Space Flight Center (GSFC)</u>	<u>\$980,000</u>
1. Construction of Addition to Building 5 for Flight Hardware Storage	490,000

This project provides for the construction of an approximately 5,000-square foot two-story addition on the west side of Building 5. The ground floor will provide for 250 pounds per square foot loading limit and the second floor will provide for 150 pounds per square foot. The area will be provided with utilities and security systems commensurate with flight hardware storage, and a 6,000-pound hydraulic freight elevator. The Special Payloads Division at Goddard has a continuously increasing inventory of flight hardware for the Spartan program and has no place for storage. These items are costly and have long lead procurement times. It is essential that a secure location be available for storage of such material.

2. Construction of Mezzanines for Machine Shops in Instrument Construction and Installation Laboratory	490,000
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This project provides for the construction of two mezzanines totaling approximately 7,200 square feet above the ground floor in the east wing of the Instrument Construction and Installation Laboratory. The mezzanines will contain 4,700 square feet on a first level and 2,500 square feet on a second level. The air-conditioning, lighting, electrical, and fire detection and protection systems will be modified to support the installation and operation of machine tools installed on and below the mezzanines. The new construction will permit rearrangement of the existing shop equipment to allow work to flow more efficiently through the shop. The additional space is also needed for loading/unloading large parts. This project will also provide additional high bay space for the larger numeric-controlled machines and expansion space for computer-aided machining. The construction will free additional assembly space in the existing high bay area for the future assembly of large Hubble Space Telescope Modules and Space Station payloads.

C. <u>Jet Propulsion Laboratory (JPL)</u>	<u>\$910,000</u>
1. Construction of Property Management Facility.	460,000

This project will provide for the construction of an approximately 6,500-square foot building on the north side of Pioneer Road just east of Road "J". The site is currently occupied by Buildings 117, 140, and 141, which are to be demolished under this project. Due to a lack of onsite enclosed storage, there is insufficient protection of Government property from inclement weather. Open-bed trailers are currently used for staging freight. A secured building is required to collect Government equipment and supplies and to assemble project shipments. The steel frame structure will be a weather-protected facility for the staging

and temporary storage of Government property. The facility will incorporate a small office and two loading areas to accommodate up to four 40-foot-long vans.

2. Construction of North Lab Parking Area 450,000

This project provides for the construction of a parking area to accommodate 80 vehicles at the present site of Buildings 57, 80, and 106, which are to be demolished under this project. These substandard buildings were constructed in the 1940s and 1950s. All existing onsite and offsite parking areas are fully developed and utilized. There is presently no vacant land available for parking expansion. The construction of major new buildings has eliminated 550 parking spaces while adding nearly 1,000 employees onsite from leased space. This has caused a critical shortage of parking spaces. The project will include paving, lighting, retaining walls, landscaping, and irrigation.

D. Johnson Space Center (JSC) \$400,000

1. Construct Duct Bank 400,000

This project provides for the construction of a concrete encased duct bank between existing manholes 1 and 7 (approximately 3,200 lineal feet) in the 300 and 400 areas of JSC. The duct bank will consist of four 6-inch and four 4-inch polyvinyl chloride ducts. The existing duct bank has settled and shifted to the point that no additional cables can be installed nor can the existing ones be removed. The new duct bank is required to accommodate the additional power, communications, data and fire alarm cabling necessary to support the increasing demands of the automation and communication requirements of the logistics and site operations located in the 300 and 400 areas.

E. Kennedy Space Center (KSC) \$1,270,000

1. Construct Addition to Communications Center (M6-138)..... 450,000

This project provides for an approximately 3,600-square foot addition to Building M6-138 for accommodating a new centerwide operational voice system and termination of fiber optic cabling/patch boards. The central facility will provide space adjacent to existing equipment for concurrent operation over the 2 to 3 year installation of the new system. This system will substantially reduce Operation and Maintenance personnel required to support Shuttle/Cargo programs at KSC. The present systems require considerable maintenance to keep equipment operational. This project will permit the establishment of a control center and adequate space for fiber optic cable termination.

2. Construct Generator Maintenance and Storage Facilities..... 440,000

This project provides for an approximately 2,000-square foot governor/instrumentation shop and office area, an approximately 1,500 square foot shed for checkout and storage of 300KW generators, and approximately 4,900 square yards of pavement. Existing space in Building K6-1995 for the Shuttle Processing Contractor (SPC) is both obsolete and inadequate. This project will provide an adequate office area and governor shop with a controlled area for governor repair, crew area, janitorial area, locker area, and restroom facilities which are not provided to the SPC. The checkout and storage shed is required to provide protection from the weather elements during storage, checkout, and validation of the 300KW generators.

3. Construct Security Training Center..... 380,000

This project provides for the construction of a security training center which will include three firing ranges, repelling tower, obstacle course, facility power, and area lighting to ensure quality training for approximately 300 security personnel in weapons proficiency, physical training, and academics. The temporary area currently used is shared with incompatible fire training activities and is overcrowded; scheduling is difficult and potential hazards exist when fire and security training is concurrent. This project will provide a dedicated security training area necessary for achieving improved proficiency and safety.

F. Langley Research Center (LaRC)..... \$940,000

1. Construction of Addition to Technical Library (1194)..... 490,000

This project provides for a 3,900-square foot addition to LaRC's Technical Library. This addition will be constructed with reinforced concrete foundations and floor slabs, a structural steel frame, and exterior finishes to match existing construction. This project will include heating, air-conditioning, plumbing, and electrical systems necessary to provide a functional facility. The additional space is required to provide a suitable area for the storage, use, and control of classified documents, and to ensure effective service to the increasing numbers of library users.

2. Construction of Medium Bay Clean Rooms (1250) 450,000

This project provides for a 2,800-square foot clean room complex addition to Building 1250. Approximately 1,800 square feet will be class 100 clean room, and the other 1,000 square feet will be class 10,000. Both clean rooms will be 30 feet in height, and provided with appropriate utilities including a 5-ton bridge crane in the class 10,000 room. Clean room facilities currently do not exist at LaRC and will be required for the assembly and processing of STS pallet-mounted payloads.

G. Lewis Research Center (LeRC) \$480,000

1. Construction of South Area Chilled Water Plant (94) 480,000

This project provides for the construction of an approximately 1,000-square foot chilled water plant addition to the existing Pumphouse, Building 94. Two existing 180 ton chillers will be installed. New pumping equipment, piping and associated electric power, and control wiring will also be installed. Chilled water piping will be extended to existing 14" lines presently supplying cooling tower water to south area buildings; and connected to existing 6" lines presently supplying chilled water to the 8x6 SWT complex. New tower supply and return lines will be extended to Building 94 to provide for condenser cooling. This is the initial phase of a 3-year program to install a central chilled water plant for the southern end of the central area of LeRC. This phase will provide cooling requirements for air-conditioning service and research equipment located in the following facilities: 8x6 SWT complex, Buildings 39, 54, 55, and 56.

H. Marshall Space Flight Center (MSFC) \$200,000

1. Construction of Addition for Gyros Test Vault (4487) 200,000

This project provides for the construction of an approximately 150-square foot test vault addition to the Information and Electronic Systems Laboratory, Building 4487, for advanced development and life testing of the Space Station control moment gyros. Work includes wireways for instrumentation and electrical power to the vault. The concrete masonry vault is required to protect personnel and equipment during development testing of momentum wheels, and gyro testing. The addition will also permit development and testing of momentum management techniques for the Space Station.

I. Michoud Assembly Facility (MAF) \$180,000

1. Construction of Addition to Harbor Master Building 180,000

This project provides for the construction of an approximately 2,400-square foot addition to the Harbor Master Building. Work includes the construction of a pile-supported concrete foundation and erection of a preengineered metal building with lighting, electrical power, and other utilities. This addition will consolidate all Harbor Master equipment and personnel from an old trailer and two other remote deteriorated structures, which will be demolished. The result will be more effective control of equipment and personnel that support the shipment of external tanks from MAF.

J. National Space Technology Laboratories (NSTL) \$820,000

1. Construction of Test Support Building 410,000

This project provides for the construction of an approximately 4,500-square foot preengineered steel building to house NSTL's test support personnel responsible for facility planning and construction, and the field maintenance engineering of the Space Shuttle main engine test complex. The personnel are currently housed in a structurally deteriorated 20-year-old "tin shed" that has numerous electrical and mechanical deficiencies. The personnel will be relocated to the new building, which will include central heating and air-conditioning.

2. Construction of Addition to Earth Resources Laboratory (8201) 410,000

This project provides for a 4,500-square foot preengineered building addition to the Earth Resources Laboratory (8201) to provide additional space required for improving, repairing, and advancing the state-of-the-art in remote sensing equipment. The addition also will provide laboratory space for the spectral analysis and preservation of biomass samples; a spectroscopy laboratory, an area for design and development of electronic circuit boards and precision mechanical drive systems; and automated data processing and office areas.

K. Wallops Flight Facility (WFF)..... \$550,000

1. Construction of Magnetic Field Simulation Laboratory. 350,000

This project provides for the construction of a 30-foot high nonferrous building of approximately 1,600 square feet with an attached 300-square foot control room. This facility will be completely nonmagnetic, with a remote air-conditioning system, incandescent lighting, nonmagnetic hoist, isolation transformers, and a 15-foot overhead door. As a result of consolidation of the NASA Sounding Rocket Program at WFF, more numerous and complex flight payloads are undergoing design, fabrication and testing at the facility. The temporary laboratory with magnetic field simulation currently in use is very limited in capability and accuracy. The proposed laboratory will provide a cost efficient and effective means to conduct essential magnetic field simulator tests.

2. Construction of Addition to Receiving and Supply Facility (F-19)	200,000
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This project provides for the construction of an addition to Building F-19 which will expand the existing cargo receiving area by approximately 2,400 square feet. The new building will match the existing structure and will include lighting, heating, ventilation, and motorized roll-up doors. The present receiving area is totally inadequate for proper processing of received material. The receipt of one trailer load of material completely fills the receiving area. Material is frequently off-loaded outside because of the lack of space and moved three or four times during the receiving process. Damage and losses often result. This expansion will provide needed additional space and increase operational efficiency of the F-19 receiving area.

L. <u>Various Locations</u>	<u>\$780,000</u>
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1. Construction of Training and Information Facility, Madrid, Spain	330,000
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This project provides for the construction of a 3,000-square foot training and information facility at the Madrid Deep Space Communications Complex. The building will contain a training and briefing auditorium area capable of seating 85 people, display areas and restrooms. The facility will be of similar construction to existing buildings at the Madrid complex and will be environmentally controlled. This facility is necessary to provide for training of employees and the briefing of the news media and visiting dignitaries. It will also accommodate the visiting general public in a location that is removed from the working area. These briefings must be provided in a location that will not interfere with the operations, safety or security of the complex. Presently, there is no place where the personnel can receive training in a central location.

2. Construction of Maintenance and Integration Building, Goldstone, CA.....	450,000
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This project provides for the construction of a 5,000-square foot metal building adjacent to the DSS-14 site station for housing maintenance and integration personnel with appropriate supporting work and storage space. This facility will have laboratory electrical, environmental control, and compressed air systems and provide space for minor checkout and repair of electronic components. It also will provide office and tool storage space for maintenance and integration personnel who must now travel 12 miles to and from the DSS-12 site. The major portion of the maintenance and integration work at Goldstone is at the DSS-14 site, and this project will greatly reduce the travel required for maintenance and integration effort at this complex.

Total	<u>\$8,000,000</u>
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FUTURE CoF ESTIMATED FUNDING REQUIRED TO COMPLETE THIS PROJECT:

needs. An Estimated \$8,000,000to \$10,000,000per year will be required for continuing minor construction

FACILITY PLANNING
AND DESIGN

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1988 ESTIMATES

SUMMARY

FACILITY PLANNING AND DESIGN

	<u>Amount</u>	<u>Page No.</u>
<u>Regular Requirements:</u>	<u>9,900,000</u>	CF 11-2
Master Planning.	315,000	CF 11-2
Sustaining Engineering Support.....	1,535,000	CF 11-2
Preliminary Engineering Reports and Related Special Engineering Support....	2,650,000	CF 11-4
Final Design.	5,400,000	CF 11-5
<u>Other Requirements</u>	<u>6,100,000</u>	CF 11-5
Space Shuttle Facility Planning and Design.....	900,000	CF 11-6
Payload Facility Planning and Design.....	900,000	CF 11-6
Space Station Support Facilities Planning and Design.....	4,300,000	CF 11-6
<u>Total</u>	<u>16,000,000</u>	

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1988 ESTIMATES

PROJECT TITLE: Facility Planning and Design

FY 1988 CoF ESTIMATES: \$16,000,000

FY 1986: \$10,710,000

FY 1987: \$14,000,000

The funds requested in this estimate are required to provide for the following advance planning and design activities related to facilities activities and projects:

a. The accomplishment of necessary development and master planning for field installations and, where not otherwise provided for, the provision of continuing engineering support and special engineering management and other services.

b. The preparation of preliminary engineering reports, cost estimates, and design and construction schedules.

c. The preparation of final construction plans, specifications, and associated cost estimates and schedules required to implement construction projects.

d. The accomplishment of facilities siting and other investigations, studies and reports.

Regular requirements encompass the basic purposes outlined above. The "other requirements," while also in support of "regular" purposes, cover those special needs related to large, complex projects or specific

programs considered to represent high potential future construction requirements for which early definition is essential. The large projects require more planning and longer lead time. Much of this planning must be completed prior to inclusion of the project in a budget request.

1. <u>REGULAR REQUIREMENTS</u>	<u>\$9,900,000</u>
A. <u>Master Planning</u>	<u>315,000</u>

Provides for update and development of existing field installation master plans. This effort includes facility studies, site investigations, and analyses of utility systems. The master plan documents will be updated to reflect as-built conditions since issue of previous plans, and to graphically represent the 5-year facility plan baseline for future development.

The NASA field center master plans are generally updated at 4-to-5-year intervals. On an Agency-wide basis, the level of effort remains fairly constant. The master plans are essential as reference documents for land use planning, physical relationships of facilities, and proper orientation and arrangement of facilities. Representative candidates for FY 1988 master planning are:

(1) Johnson Space Center

An update of the facilities inventory base to reflect new construction, utility system revisions, proposed Space Station facilities and related 5-year planning.

(2) Langley Research Center

An update to reflect new construction, revised land use planning, and changes to 5-year planning.

B. <u>Sustaining Engineering Support</u>	<u>1,535,000</u>
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Provisions for facility studies and specific engineering support continue in importance as evidenced in recent years, and must be given high priority throughout FY 1988. These efforts are important due to changing cost trends in construction materials and fuels; the continuing importance of energy conservation and efficiency; and the operation and maintenance costs for the physical plant.

The following items are included in the FY 1988 requirements:

(1) Building Research Board

Covers annual support to the Federal Construction Council's (FCC) operations and provides for special studies that the Council will perform throughout FY 1988 to help advance the science and technology of Federal Government building and construction. The FCC is subordinate to the Building Research Board, National Academy of Sciences, and its activities are supported by several Federal agencies including NASA.

(2) Utilities Services/Rates Analysis

Provides resources for the support of utilities procurement and utilities control systems. This includes, but is not limited to, technical assistance, surveillance, and recommendations with regard to utility rates, contract negotiations, systems operations, and utilities control systems. Because of the great magnitude of energy costs, these services are an annual requirement and continue to be essential.

These resources enable the Agency to ensure that fair and reasonable rates are charged under its major utility contracts. Essential and valuable technical assistance is provided to our field installations so that effective negotiations can be conducted with utility companies. Several major utility contracts per year require technical assistance as utility contracts are renewed throughout the Agency.

NASA's significant ongoing investment in utility control and management systems requires a high level of technical maintenance and support. The proper function and operation of the equipment are essential in order to realize the benefits. These resources provide the high technical capabilities needed to manage the system and ensure proper operation and use.

These resources will provide for an updating of our system for forecasting utility costs and rates, so that better and more reliable utility budget requirements can be established. The accuracy and credibility of forecasts impact the Agency's planning for other resources.

These and other similar utility system services are provided for by the requested resources in order to ensure technical competence and properly manage this function.

(3) Facility Operation and Maintenance Analysis

Provides for continued engineering support for implementing improvements at NASA field installations relative to manpower utilization, **work** control systems, preventive maintenance, facilities

management and reporting systems. Improvements will also involve techniques to identify where and how increases in productivity are possible. Included in this activity are field surveys to be conducted on a priority basis at selected NASA field installations to evaluate the effectiveness of the operations and maintenance management systems.

(4) Value Engineering Cost Validations and Analyses

Provides for engineering services to improve cost-effectiveness of facility projects by subjecting project design criteria, specifications and working drawings for specific material components and systems to a detailed independent review by engineering specialists in the particular area of involvement. **Also** provides services necessary to accurately predict and validate facility costs which will aid in resources planning for the various field installations.

(5) Facilities Utilization Analyses

Provides for the analysis of Agency-wide facilities utilization data covering: (1) office and other types of building space; (2) designated major technical facilities; and (3) special studies comparing the utilization of technical facilities which are similar in type or capability, such as wind tunnels. Such analyses provide for (1) insights into and development of better methods of identifying underutilized facilities; (2) improved techniques to quantify level of facilities use; and (3) actions to improve facilities utilization. Work provides for review of each installation's inventory data base in support of the facilities utilization program. Surveys are necessary to validate the reported data in relation to a specific problem or need, and to assist in providing a credible foundation for plans to improve the utilization of facilities.

C.	<u>Preliminary Engineering Reports and Related Special Engineering Support.....</u>	<u>.....</u>	<u>2,650,000</u>
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(1)	Preliminary Engineering Reports (PER's).....	(2,100,000)
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Preparation of PER's, investigations, and project studies related to proposed facility projects in the FY 1990 and FY 1991 Construction of Facilities programs are provided for by this estimate. These reports are required to permit the early and timely development of the most suitable project to meet the stated programmatic and functional needs. Reports provide basic data, cost estimates and schedules relating to future budgetary proposals. This request provides for PER's; associated with proposed construction except as provided for in other requirements (paragraph 2) for Shuttle, Space Station, and Payload initiatives.

The estimated cost of PER support for FY 1990 construction projects is \$1,400,000 which will permit updating of PER's for \$30-35 million in construction, and the development of new PER's for an additional \$40-50 million in projects.

An additional \$700,000 has been included in this line for the completion of new PER's for approximately \$30-35 million of construction projects which will be high priority candidates for inclusion in the FY 1991 Construction of Facilities program. The activity associated with FY 1991 will be confined to the highest priority candidates.

(2) Related Special Engineering Support..... (550,000)

Investigations and project studies related to proposed facility projects to be included in the subsequent Construction of Facilities programs are provided for by this estimate. Such studies involve documentation and validation of "as built" conditions, survey/study of present condition of such items as roofing and cooling towers, utility plant condition and operational modes, analysis and support of environmental impact assessments and statements, and other like studies. These studies are required to allow for the timely development of projects to meet the stated functional needs and to provide basic data, cost estimates and schedules for related future budgetary proposals.

D. Final Design..... 5,400,000

The amount requested will provide for the preparation of designs, plans, drawings, and specifications necessary for the accomplishment of projects other than Space Shuttle, Spacelab, and Payloads and the Space Station. Amounts required for those efforts are included under other requirements (paragraph 2). Projects involved are planned for inclusion in the FY 1989 and FY 1990 programs. The goal is to obtain better facilities on line earlier at a lower cost.

The request will provide for final design work associated with construction proposed for the FY 1989 Program, estimated to cost \$65 to \$75 million, and for \$15 to \$18 million of high potential projects proposed for the FY 1990 program. The amount included for FY 1989 candidates and for residual requirements of this nature which have accumulated from prior years' final design activities is \$4,400,000. For FY 1990, \$1,000,000 is included and the supporting rationale is much the same as that set out in the PER estimate.

2. ~~OTHER REQUIREMENTS~~..... ~~\$6,100,000~~

Other facilities planning and design requirements primarily associated with specific space programs characterized by large size, long planning cycle, and/or complexity of scope are included in this particular

request. These programs require a level of planning effort and length of design time beyond the more routine facility projects. These requirements must be provided beyond the regular and most recurrent facility planning and design needs.

A. Space Shuttle Facility Planning and Design (900,000)

These resources provide for early and progressive design, final drawings, specifications, and site investigations for future Space Shuttle facilities in order to ensure the best design, good cost estimates and realistic construction schedules. The Shuttle operational era requirements include expansion of Shuttle processing, repair and maintenance facilities to meet an increasing launch rate, construction of operations personnel facilities, modification to the launch complex support facilities and modifications at various locations for space engine enhancement and testing.

B. Payload Facility Planning and Design... (900,000)

Support of the operational phase of the STS payloads processing program will necessitate preparation of Preliminary Engineering Reports, facility site investigations, design of facility projects, and studies to determine facility capabilities. Included are facilities for payload operations and control payload processing for the larger and more numerous payloads, as well as facility projects for logistics and maintenance of payloads and storage of associated flight and support equipment.

C. Space Station Support Facilities Planning and Design. (4,300,000)

This requirement is primarily for preparation of preliminary engineering reports and final design drawings, specification and associated site investigation required for construction of future Space Station facilities at various locations. Included are engineering and system management type test beds, data management, Mission Control Centers research laboratories, simulation, integration, processing and prelaunch checkout facilities.

Total..... \$16,000,000

ENVIRONMENTAL
COMPLIANCE AND
RESTORATION



NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
CONSTRUCTION OF FACILITIES
FISCAL YEAR 1988 ESTIMATES
SUMMARY

ENVIRONMENTAL COMPLIANCE AND RESTORATION

<u>Summary of Project Amounts by Location:</u>	<u>Amount</u>	<u>Page No.</u>
Ames Research Center	\$800.000	CF 12-3
Dryden Flight Research Facility	650.000	CF 12-3
Goddard Space Flight Center	600.000	CF 12-3
Jet Propulsion Laboratory	1.610.000	CF 12-4
Johnson Space Center	850.000	CF 12-5
Kennedy Space Center	190.000	CF 12-5
Lewis Research Center	650.000	CF 12-6
Marshall Space Flight Center	2.000.000	CF 12-6
Michoud Assembly Facility	5.720.000	CF 12-6
National Space Technology Laboratories	180.000	CF 12-8
Wallops Flight Facility	530.000	CF 12-8
White Sands Test Facility	4.060.000	CF 12-8
Various Locations	2.660.000	CF 12-9
Miscellaneous Projects Less Than \$150.000 Each	1.500.000	CF 12-10
Studies, Assessments, and Design	<u>1.900.000</u>	CF 12-10
TOTAL	23.900.000	

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1988 ESTIMATES

PROJECT TITLE:	Environmental Compliance and Restoration Program
INSTALLATION:	Various Locations
Note: The 1987 R&PM Budget contains \$5,000,000 to initiate this effort.	FY 1988 CoF Estimate: \$23,900,000

COGNIZANT INSTALLATIONS/LOCATION OF PROJECT: Various Locations

COGNIZANT HEADQUARTERS OFFICE: Office of Management

SUMMARY PURPOSE AND SCOPE:

These resources will provide for studies, assessments, design, and remedial projects for environmental compliance and restoration measures at NASA field installations and Government-owned industrial plants supporting NASA activities. The purpose of this program is to enable compliance with mandatory statutory environmental requirements and standards. The resources authorized and appropriated pursuant to this program may not be applied to other activities. The program includes such measures as studies or assessments to determine current status and options for remedial action, environmental restoration, hazardous waste removal and disposal, cleanup and closures, and removal of unsafe buildings and debris.

PROJECT JUSTIFICATION/DESCRIPTION:

Proposed environmental compliance and restoration projects for Fiscal Year 1988 total \$23,900,000. This program has been distilled from requests of over \$27,000,000 of high-priority projects and represents only a modest request in relation to total requirements for environmental compliance and restoration that must be implemented within 3 to 4 years. Based on relative urgency and potential health hazards, the projects that will be accomplished in 1988 are the highest priority requirements. Deferral of these necessary remedial measures would make it impossible for NASA to comply with environmental law and will cause shutdown of critical NASA operations by individual state or Federal environmental authorities. Studies, assessments, and design costs are approximately \$1,900,000. Projects estimated to cost less than \$150,000 have not been described or identified by location and the total cost of these projects is \$1,500,000.

The following broad categories of work will be accomplished in Fiscal Year 1988. As studies, assessments, and designs progress, it is expected that priorities may change and reordering of activities, including studies, assessments, and design may be necessary.

a.	Air Pollution Abatement and Asbestos Management	\$4,000,000
b.	Rehabilitation/Replacement of PCB Transformers	\$2,900,000
c.	Hazardous Waste Monitoring and Control	\$17,000,000

PROJECT COST ESTIMATE

A. Ames Research Center (ARC) \$800,000

1. Replace and Dispose of PCB Transformers, Various Locations 800,000

This project provides for the removal of approximately 11 PCB transformers from Buildings N-201, 206A, 213, 218, 233, 233A, and 244. The hazardous wastes, including dielectric fluid and contaminated equipment, will be disposed of in accordance with current regulations. The removed obsolete and contaminated equipment will be replaced with equivalent size non-PCB transformers. Continued use of the PCB-laden transformers represents a potential hazard to human health and the environment and possible disruption of the center's operation from leaks or explosion in or near these commercial locations.

B. Dryden Flight Research Facility (DFRF) \$650,000

1. Remove and Dispose of Asbestos, Building 4800

This project is the initial phase for removal of water-damaged, spray-applied asbestos insulation from the return-air plenum areas of Building 4800. The areas containing asbestos are the first and second floors of the 1963 addition with a floor area of approximately 40,000 square feet. This project removes hazardous material from the second floor area only which includes fire proofed beams, ducts, etc., and ceiling tiles. A new lay-in acoustical ceiling will be provided, lighting fixtures replaced where necessary, and damaged architectural finishes repaired as required. Water-damaged insulation containing asbestos in Office Building 4800 contributes to severe environmental hazards from the delamination and release of asbestos fibers within the return air plenum. This project is required to comply with health and environmental standards for occupancy of personnel. Disposal of hazardous wastes will be in accordance with approved regulations.

C. Goddard Space Flight Center (GSFC) \$600,000

1. Replace and Dispose of PCB Transformers, Building 24 600,000

This project removes three 1,000 KVA transformers and associated switchgear at the Goddard Central Heating and Refrigeration Plant, Building 24. The project includes the installation or replacement of non-PCB electrical equipment. The PCB-contaminated electrical equipment is old and obsolete posing a particular hazard from leaks and other releases. This project is the initial phase of replacing hazardous electrical equipment with non-PCB equipment. Disposal of the waste will be in accordance with approved regulations.

D. <u>Jet Propulsion Laboratory (JPL)</u>	<u>\$1,610,000</u>
1. Remove Contaminants from Arroyo Seco Groundwater	500,000

This project will provide for the evaluation and implementation of corrective action to mitigate groundwater contamination of the Arroyo Seco aquifer. Previous sampling and testing of groundwater from wells in vicinity of JPL have confirmed the presence of trichloroethylene, which is alleged to have been discharged from JPL operations. Corrective actions such as groundwater pumping, contaminant-stripping, and reinjection are anticipated to reduce pollutant levels and control further migration. Groundwater monitoring and hydrogeological studies by the City of Pasadena, California, have resulted in allegations of contamination of the Arroyo Seco aquifer from discharges of trichloroethylene during the 1940-1960 time period. This project is required to evaluate and correct the present situation.

2. Replace and Dispose of PCB Transformers, Various Locations	270,000
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This project provides for the initial phase of replacement of PCB transformers at JPL. The contaminated transformers are a hazard to the environment due to potential leaks and other accidental releases of pollutants, and will be replaced with non-PCB equipment. The project includes disposal of the PCB liquid and the contaminated equipment components in an approved method. The hazards to human health and the environment from accidental releases, fires, etc., involving PCB transformers have resulted in a series of EPA regulations restricting the continued use of contaminated electrical equipment.

3. Replace Underground Storage Tanks, Various Locations (Edwards Test Facility)	320,000
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This project provides for the replacement of underground tanks with aboveground tanks equipped with leak-detection equipment and secondary containment. The new tanks will comply with recent State and local laws to control the potential releases of hazardous substances to groundwater sources. The aboveground tanks will permit monitoring of potential leaks of hazardous materials that will mitigate accidental groundwater contamination.

4. Replace Underground Storage Tanks, Various Locations	520,000
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This project provides for the replacement of underground hazardous storage tanks with aboveground tanks, leak-detection equipment, and secondary containment facilities. The new tanks will comply with recently adopted State and local regulations for the control of groundwater contamination by reducing the potential for contamination from underground tanks.

E. <u>Johnson Space Center (JSC)</u>	<u>\$850,000</u>
1. Replace Underground Tanks, Metal Plating Shop	460,000

Install aboveground tanks for collecting hazardous wastes from the metal plating shop, with associated piping to replace existing underground tanks. The aboveground tanks will include monitoring equipment and secondary containment facilities to comply with current hazardous waste control regulations. Environmental regulations resulting from the hazardous waste amendment to the Resource Conservation and Recovery Act have imposed stringent requirements on facilities used in the storage of hazardous wastes. This project will provide aboveground waste collection tanks to replace existing deteriorated underground concrete tanks. This will mitigate groundwater contamination from accidental releases of toxic metal plating wastes.

2. Replace Blowdown Transfer Line From Central Heating and Cooling Plant	390,000
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This project provides for the installation of approximately 3,000 feet of double-walled pipe, with leak detection, that transfers hazardous blowdown wastewater from the Central Heating and Cooling Plant cooling towers to the waste-pretreatment facility. The new underground pressure line will replace an existing deteriorated line, and will comply with current regulations for transport of hazardous wastes. Federal and State environmental regulations resulting from the hazardous waste amendments to the Resource Conservation and Recovery Act have imposed very strict requirements on facilities used for storage and transport of hazardous wastes. The project will provide an adequate transfer line in accordance with approved regulations.

F. <u>Kennedy Space Center (KSC)</u>	<u>\$190,000</u>
1. Modify Chemical Treatment Facility for Hazardous Waste	190,000

This project will include the major redesign and modification of the KSC treatment facility for hazardous wastes to improve efficiency and augment resource recovery. The facility upgrade will require significant equipment and plumbing modifications. These modifications will reduce the volume of wastes requiring off-site disposal. The 1984 hazardous waste amendment to the Resource Conservation and Recovery Act mandates the minimization of hazardous wastes and the recovery of resources from wastes generated. This project will improve the efficiency for waste reduction and resource recovery.

G. <u>Lewis Research Center (LeRC)</u>	<u>\$650,000</u>
1. Replace and Dispose of PCB Transformers, Various Locations	650,000

This project provides for replacement of PCB transformers for compliance with EPA regulations. The regulations require enhanced electrical protection against current faults or retrofit/replacement of transformers by October 1990. This is the initial phase to replace PCB transformers at various buildings. The units are all more than 30 years old and located in areas specifically regulated by the new EPA requirements. An explosion or fire in any of these units could contaminate the facility with PCB and shut down operations for an indefinite period of time. This phase provides for replacement of transformers in Buildings 3, 5, 8, 12, 14, 23, 40, 49, 51, and 53.

H. <u>Marshall Space Flight Center (MSFC)</u>	<u>\$2,000,000</u>
1. Remove and Dispose of Asbestos, Building 4610	1,500,000

This project provides for the removal of spray-applied asbestos insulation from a portion of Building 4610 to eliminate a potential employee health problem. The asbestos insulation to be removed is located above the ceiling in the eastern end and in the basement of the five-story portion of Building 4610. This project is required to comply with health and environmental standards in removal of deteriorated asbestos insulation, replacement with suitable non-asbestos material, and disposal of asbestos waste in accordance with current laws and regulations.

2. Closure and Decontamination of Industrial Lagoon.....	500,000
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This project provides for the installation of aboveground tanks to replace the existing industrial lagoon. The lagoon is a source of groundwater contamination and must be removed from service. The project is required by the Resource Conservation and Recovery Act (RCRA) which requires the closure and decontamination of any hazardous facility that is no longer in operation.

I. <u>Michoud Assembly Facility (MAF)</u>	<u>\$5,720,000</u>
1. Modify Wastewater Storage System	2,400,000

This project provides for modifications to the industrial wastewater storage system by replacing the existing surface impoundments with aboveground storage tanks. The existing surface impoundments do not meet the requirements of the Resource Conservation and Recovery Act (RCRA) Hazardous and Solid Waste Amendments (HSWA) of 1984. Replacement of the impoundments with aboveground tanks will eliminate problems with leaking and resultant contamination of groundwater or surface waters. Additionally, aboveground tanks, with associated secondary containment, will provide greater access

for system inspection and maintenance and assurance that hazardous materials cannot migrate to the environment. Replacing the surface impoundments is necessary to comply with a November 1988 deadline (in the HSWA of 1984) to eliminate surface impoundments.

2. Modify Incinerator to Accept Hazardous Waste..... 1,500,000

This project provides for modifications to the existing incinerator to burn hazardous as well as nonhazardous wastes. Modifications include a scrubber system and associated fan blowers, ducts, and lining for the stack to remove hydrogen chloride and particulates. This project would permit maximum utilization of on-site incineration, reduce potential for future liability by minimizing off-site disposal, control costs of hazardous waste disposal, and meet the requirements of the Resource Conservation and Recovery Act.

3. Upgrade Thermal Oxidizer Units, Various Locations 360,000

This project will upgrade the existing thermal oxidizers in Buildings 110, 114, and 131 to meet air emission standards for volatile organic carbons. The oxidizers are used to remove organics from the cleaning cell exhausts. Without this project, the oxidizers will not meet emission standards under the Clean Air Act.

4. Closure and Decontamination of Surface Impoundments 800,000

This project provides for closure and decontamination of the two hazardous waste surface impoundments. The work includes removal and disposal of all residual wastes, decontamination of the synthetic liners and concrete liners of the tanks, and removal and disposal of any contaminated soil. The project complies with the Resource Conservation and Recovery Act (RCRA) which requires closure and decontamination of any hazardous waste facility that is no longer operational.

5. Plug and Abandon Deep Injection Wells 660,000

This project provides for the plugging and abandonment of deep injection wells #1 and 82 in accordance with regulatory procedures established by the State of Louisiana. Included in the work is well deactivation, removal of surface piping, removal of subsurface strings (piping) for plugging operations, and plugging the well with mud injection and cement. State law prohibits the use of deep injection wells after July 1987 and requires that the wells be plugged by January 1, 1988.

J. National Space Technology Laboratories (NSTL) \$180,000

1. Modifications for Asbestos Abatement 180,000

This project provides necessary modification to the HVAC systems in Buildings 1000, 1100, 1105, and 1200 to eliminate contamination of recirculated air with friable asbestos. These buildings have spray-applied or troweled-on asbestos in the ceiling voids which are used as a return air plenum. Return air ducts will be installed to eliminate the possible health hazard present as a result of slowly deteriorating asbestos material in the ceiling plenum.

K. Wallops Flight Facility (WFF) \$530,000

1. Remove Underground Aircraft Fuel Storage Tanks 160,000

This project provides for the removal of seven abandoned aircraft fuel tanks that are over 30 years old and no longer in use. Due to past leakage, contaminated soil must also be removed to meet EPA and State regulations. This project also includes the installation of an oil-water separator on the spill collection tank D34-6 in the JP-5 aircraft fuel storage area to prevent the possibility of future groundwater contamination.

2. Remove and Dispose of Asbestos Insulation, Various Locations 370,000

This project provides for the removal and disposal of asbestos insulation from piping, ductwork, and equipment at the Main Base, Mainland, and Island sites. The asbestos is 20- to 30- year old pipe or duct insulation. A substantial amount is located in occupied areas and has deteriorated due to age to the point that the potential exists for particles to become airborne. The primary areas of concern are in Buildings D-1, D-8, F-10, F-19, N-159, and N-162, with smaller amounts in other buildings. Exposure to airborne asbestos is a health hazard and must be removed. This project also includes reinsulation of the pipes, ductwork, and equipment.

L. White Sands Test Facility (WSTF) \$4,060,000

1. Closure and Decontamination of Surface Impoundments 2,300,000

This project provides for the closure and cleanup of six surface impoundments in the 300, 400, and 600 areas, that have been used for hazardous waste treatment or storage. The work includes the removal and disposal of all residual wastes and contaminated soil. Decontamination of the synthetic liners in the 600 areas *is* also included. The impoundments in the 300 and 400 areas are no longer in use and the impoundments in the 600 area must be taken out of service because of groundwater contamination. Under the Resource Conservation and Recovery Act (RCRA), any hazardous waste facility that is no longer operational must be properly decontaminated and closed.

2. Closure of Underground Storage Tanks, Area 200 980,000

This project provides for closure of four underground tanks used to collect hazardous wastes for laboratories and cleaning facilities. One of the tanks was found to have large holes in it and was taken out of service immediately. The other three tanks were taken out of service due to age and concern for their integrity. Because there is no groundwater monitoring system in the area of these tanks, this project will include a groundwater monitoring network as well as the removal and disposal of any residual wastes, removal and/or decontamination of the tanks, and removal of any contaminated soils. This closure action, including the groundwater monitoring system, is required under the provisions of the Resource Conservation and Recovery Act.

3. Closure of Clean Room Waste Tank 260,000

This project provides for the closure of an abandoned underground tank used to store hazardous wastes. The tank was used from 1964 to 1978 to collect cleaning facility wastes and was taken out of service because it was deteriorating. The closure will include removal and disposal of any remaining wastes, decontamination/removal of the waste tank, and removal of any contaminated soil. The closure is required under the provisions of the Hazardous and Solid Waste Amendments to the Resource Conservation and Recovery Act.

4. Install Industrial Waste/Evaporation Tank 520,000

This project provides for a new hazardous waste storage tank to replace the existing surface impoundments in the 600 area. The existing impoundments cannot be economically retrofitted to comply with the requirements of the Resource Conservation and Recovery Act and must be taken out of service. The new tank will provide storage for hazardous wastes and provide pretreatment for waste that will be incinerated.

M. Various Locations \$2,660,000

1. Upgrade Hazardous Materials Storage Areas, Various Locations, Goldstone, CA..... 200,000

This project provides for the cleanup of spilled hazardous substances at four tracking stations at the Goldstone Complex, including the removal and disposal of contaminated soils and other materials. The storage areas for hazardous materials will be upgraded to comply with State and local pollution-control regulations for secondary containment and monitoring of containers. The environmental regulations of the California administrative code and local pollution-control regulations prescribe stringent rules for storage and control of hazardous materials, and require cleanup of hazardous wastes to eliminate potential for contamination of the environment.

2. Upgrade or Replace Underground Storage Tanks, Goldstone, CA..... 1,890,000

This project includes the inspection of 32 underground storage tanks, installation of leak detection equipment, replacement of deteriorated tanks, and removal and disposal of contaminated soil and surplus storage tanks. The increasingly stringent additions to the environmental regulations of the California administrative code require the inspection of underground storage tanks to mitigate potential for groundwater contamination. This project will assess the integrity of the underground tanks and correct any identified deficiencies.

3. Remove and Dispose of Asbestos Insulation, Various Locations, Goldstone, CA..... 570,000

This project provides for the removal and disposal of hazardous asbestos insulation from boilers, piping, and associated areas. Reinsulation will be accomplished with non-asbestos materials. The asbestos insulation to be removed is located in areas where workers must occasionally remove or disturb the insulating materials. Potential releases of asbestos fibers from these activities are hazardous to employees in the area. Removal of the asbestos insulation under approved emission control methods and reinsulation with asbestos-free materials are necessary to eliminate this potential health hazard and to preserve the thermal characteristics required.

MISCELLANEOUS PROJECTS, LESS THAN \$150,000 EACH, STUDIES, ASSESSMENTS, AND DESIGNS..... 3,400,000

FUTURE COF FUNDING REQUIRED TO COMPLETE THIS PROJECT

An estimated \$25,000,000 per year for the next several years will be required for continuing Environmental Restoration and Compliance.



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